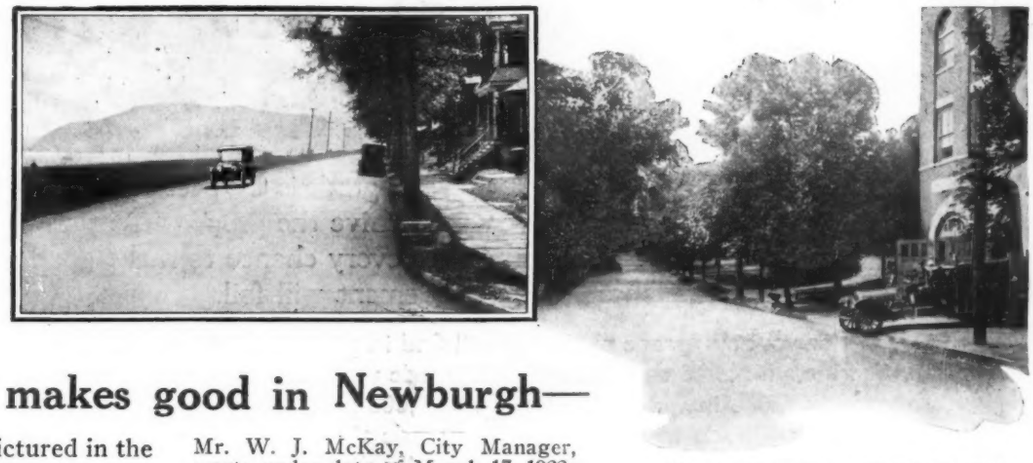
PUBLIC WORKS

CITY **COUNTY** **STATE**

Tarvia Auto-Truck Distributor

At right: Washington Heights, maintained with "Tarvia-B" since 1916.



Above: Du Bois St., maintained with "Tarvia-B" since 1916.

Below: Benkard Ave., maintained with "Tarvia-B" since 1913.

"Tarvia-B" makes good in Newburgh—

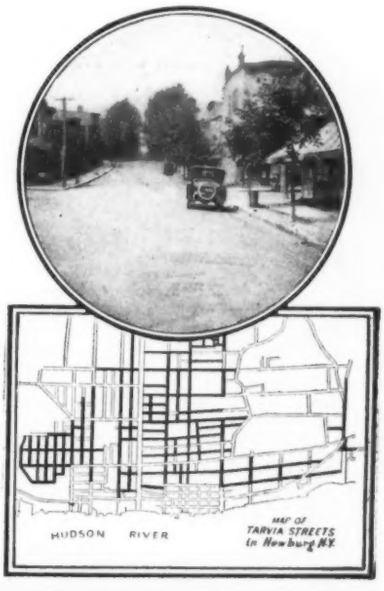
Benkard Avenue, pictured in the circle, was the first Tarvia street in the City of Newburgh, New York. The results were so satisfactory that in 1916 other macadam streets were given their initial Tarvia treatments. Not until last year, however, when the 18 miles of roadway shown on the accompanying street map were surface-treated with "Tarvia-B," was the use of all other kinds of road-maintenance materials entirely abandoned in favor of Tarvia.

Mr. W. J. McKay, City Manager, wrote under date of March 17, 1922:

"It is with a great deal of pleasure that I inform you that the results obtained from the use of your 'Tarvia-B' on the streets of this city last season were more than satisfactory.

"While we are always in the market for material cheaper than the material we used the preceding season, it would take a considerable difference in price to have us make any change in the product to be used for the season of 1922."

Economy must be the goal of every conscientious public official. And the officials of Newburgh, and hundreds of other cities and towns throughout the country, have found from experience that Tarvia is the most economical of road materials.



Tarvia
For Road Construction Repair and Maintenance

Tarvia is made in various grades for all road purposes — new construction, repairs and maintenance. An illustrated booklet telling of the different Tarvia treatments will gladly be sent free, on request.

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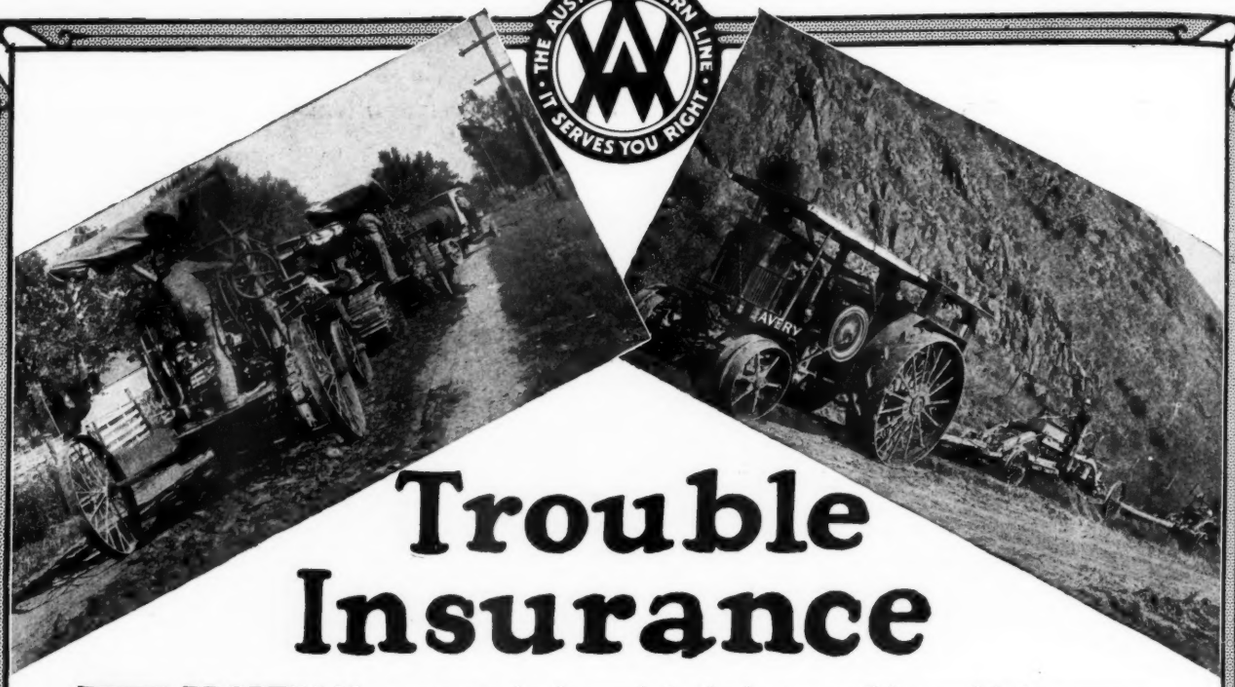
The Barrett Company

THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B., Halifax, N. S.



Trouble Insurance

A PROPERLY constructed sub-grade is the best possible trouble insurance for any road or pavement. Give the proper attention to the sub-grade and the wearing course has every chance to make good; slight the sub-grade, and the highest type of pavement will fail.

For your sub-grade work you will find in the complete line of A-W Graders and Grader-Scarifiers a model that is as good as made to order for your particular requirements. The graders range in weight from 1,000 to 9,000 pounds and will handle anything from shaping up an old grade to breaking a new grade through virgin country. Grader-scarifiers will break the way for the grader on especially difficult new work, or will loosen an old surface that must be regraded.

The Austin Rip-Snorter is especially good on resurfacing work as it scarifies and grades at the same time. It will loosen the old surface and bring it to the proper grade in one operation, or will carry the loosened material to the sides of the road where it can be used to form the shoulders or can be easily loaded into wagons.

Write today for a copy of ***General Catalog No. 21-X*** *in which all of these* ***Graders*** *and* ***Grader-Scarifiers*** *are illustrated and described in detail.*

The Austin-Western Line

"It Serves You Right"

AUSTIN			WESTERN		
Motor Rollers	Elevating Graders	Street Sprinklers	Rock Crushers	Road Planers	Drag Scrapers
Steam Rollers	Road Scarifiers	Road Oilers	Reversible Graders	Road Scarifiers	Road Plows
Rock Crushers	Motor Sweepers	Dump Wagons	Elevating Graders	Road Drags	Ditchers
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The Austin-Western Road Machinery Co.

CHICAGO, ILLINOIS

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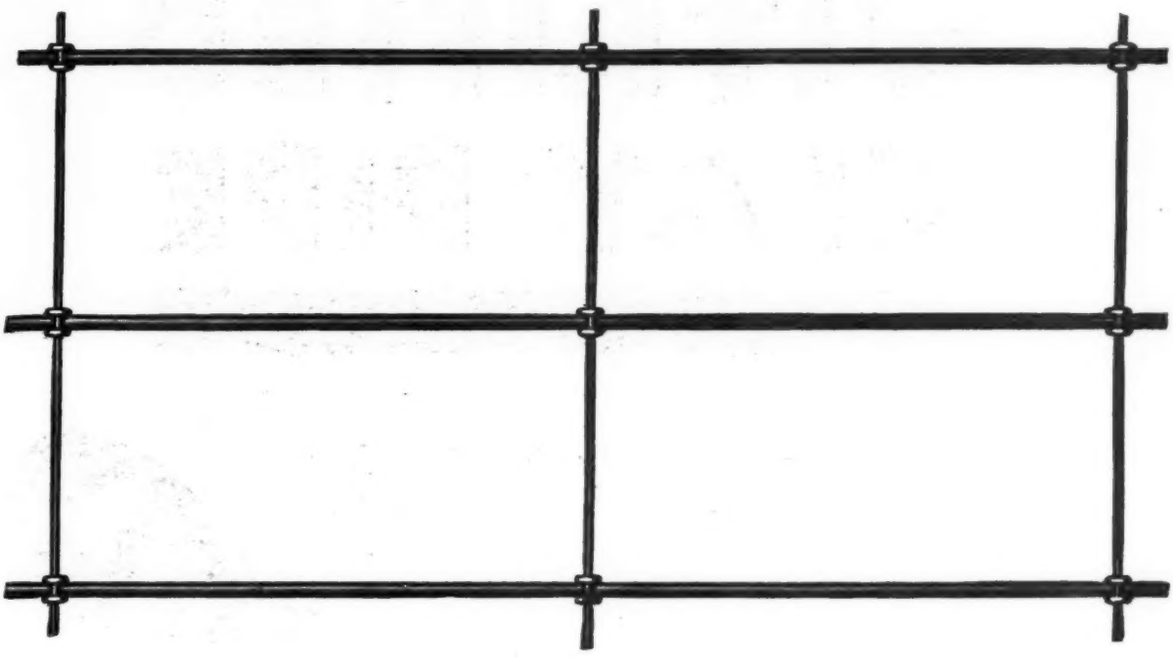
EXPORT DEPARTMENT
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 Chambers St., New York, U.S.A. Cables: Almacoa New York

VOL. 53 NO. 9

Entered as second-class matter at the Post Office, at New York, N. Y., November 22, 1921, under the Act of March 3, 1879.
Published monthly by PUBLIC WORKS JOURNAL CORPORATION, 243 West 39th Street, New York, N. Y.
Subscription price $3.00 a year, single copies 25 cents.

"Highly Satisfactory"—

Carey, Campbell & Company write from Naples, N. Y.—"We wish to say that the flat sheets of Mesh Reinforcement furnished by the Truscon Steel Company have proven highly satisfactory. Their shipments have been prompt, and their cars well and conveniently loaded, which was quite an advantage in handling it."



Truscon Wire Mesh in Flat Sheets

saves time and labor in concrete road work. The wire used in Truscon Mesh is straightened before fabricating with the result that the completed sheets lie absolutely flat. Truscon Staple Joints make absolutely rigid connections and assure sheets remaining in perfect form during all necessary handling. Flat sheets are furnished cut to exact lengths. Mesh in 6 in. x 12 in. in various areas and weights to meet all requirements. Get our estimates.

Truscon Steel Company YOUNGSTOWN, OHIO

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Truscon Curb Bars Protect Concrete Edges

Manufactured under powerful machinery from special steel sections, Truscon Curb Bars are designed to give ample protection without waste of material. Positive anchorage, rigidity and convenient size make Truscon Curb Bars easy to handle and install, and effective in actual use. Furnished either straight or curved, standard lengths 6, 8, 10 and 12 feet.

TESTED BY FIRE

VITRIFIED CLAY PIPE

The Pipe Everlasting

The first type of Clay Pipe made in U. S. A., at Zalia, W. Va.

This pipe is at present in the office of Mr. Wilbur Stout, Ass't State Geologist of Ohio, Ohio State University, Columbus, Ohio

in the ground about

65 years

Lay to stay with Vitrified Clay

Once laid, Vitrified Clay Sewer Pipe is certain to endure despite the hordes of corrosive acids, alkalis, gases or wayward electric currents that may lay siege upon it, immediately, in ten years, or forever; it is nature's immutable decree that Vitrified Clay shall forever endure. The lasting certainty of Vitrified Clay Sewer Pipe guards sanitation for all time.

Our engineers are ready at all times to give you information regarding the manufacture and use of Vitrified Clay products, embracing sewer construction, chimney construction, etc. We have ready for distribution a number of publications which will be of interest to you, including a hand book on house sewers and house drains. Let us know your problems.

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Eastern Clay Products Association

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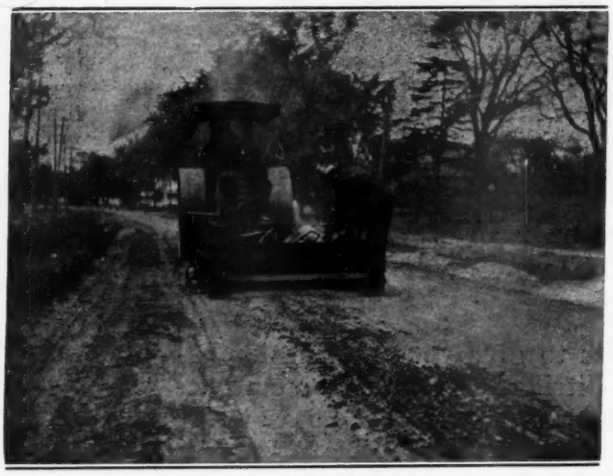
Time and Labor Savers



Road Planer

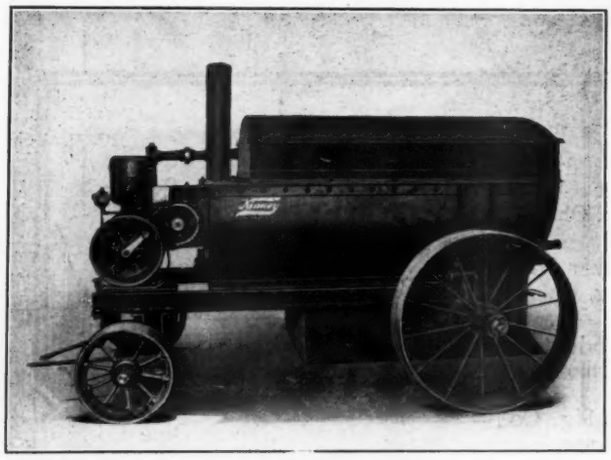
For planing or leveling the waves or ridges that frequently appear on the road surface; without destroying the contour of the surface.

May be used on bituminous roads, macadamized or dirt roads.

Patent Combination Auto Heater and Sprayer

Heats and applies under pressure all varieties of Bituminous materials; hot or cold. Heat and volume under instant control.

The tank and entire equipment can be removed and truck used for other purposes if desired.



Handy Heater and Sprayer

Especially Adapted for Road Maintenance, Construction and General Repair Work

Contents thoroughly agitated while heating. No burning or coking of material. Pump, Piping, Hose, Nozzles, Automatically Heated. No Steam Required.

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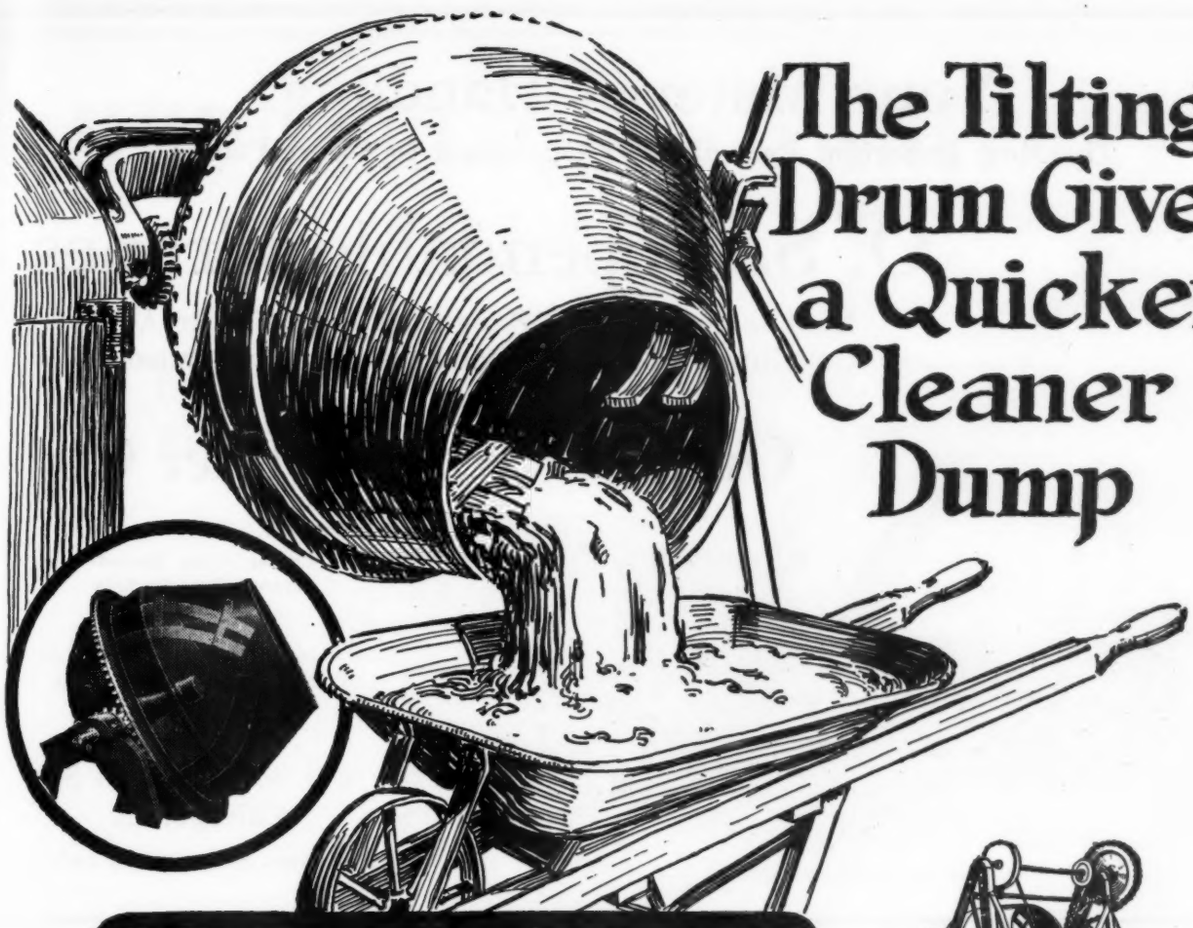


The Tilting Drum Gives a Quicker, Cleaner Dump

WHEN a batch is mixed you want to get it out of the drum—as quickly as you can. Seconds saved here mean hours saved in a day's run.

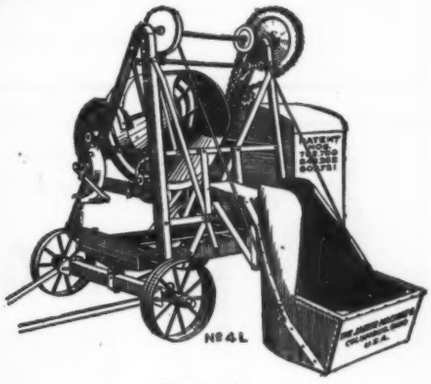
There really is just one way to get a batch out of the drum into the barrow—quickly, easily, completely. That's to *pour it out.*

There's where the Jaeger excels. Its Conical Tilting Drum gets rid of a batch as quickly and easily as emptying a bucket of water. It doesn't dip. It *tilts and pours—the only action for speed and economy in concrete mixing.*

Eighteen thousand contractors will tell you that they can underbid the owners of any other mixer on account of the dependable speed of their Jaegers. They count on—*and get*—A MIX A MINUTE.

For every type of concrete work there's a Jaeger model that will turn out the concrete speedily and economically. Write today for our catalag giving the full facts on this complete line of mixers.

The Jaeger Machine Company
400 Dublin Avenue COLUMBUS, OHIO



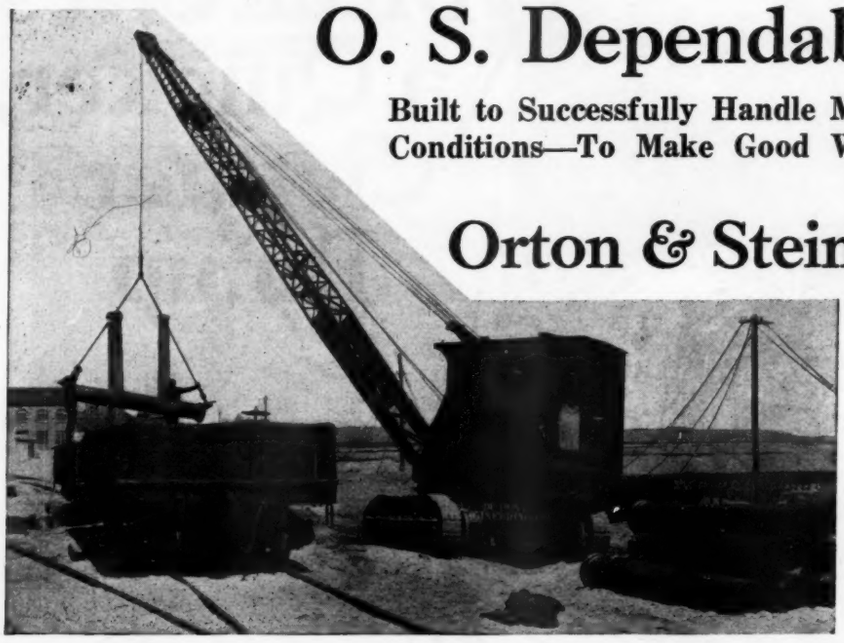
Jaeger 4-[illegible]

Jaeger 3-E

Jaeger
A MIX A MINUTE

Your Material Handling

The Most Important Part of Your Operations to Assure Profits.



12-Ton, Crawling Tread—50-Ft. Boom

O. S. Dependable Cranes

Built to Successfully Handle Materials Under All Conditions—To Make Good Wherever Installed.

Orton & Steinbrenner Co.

Designers and Manufacturers of

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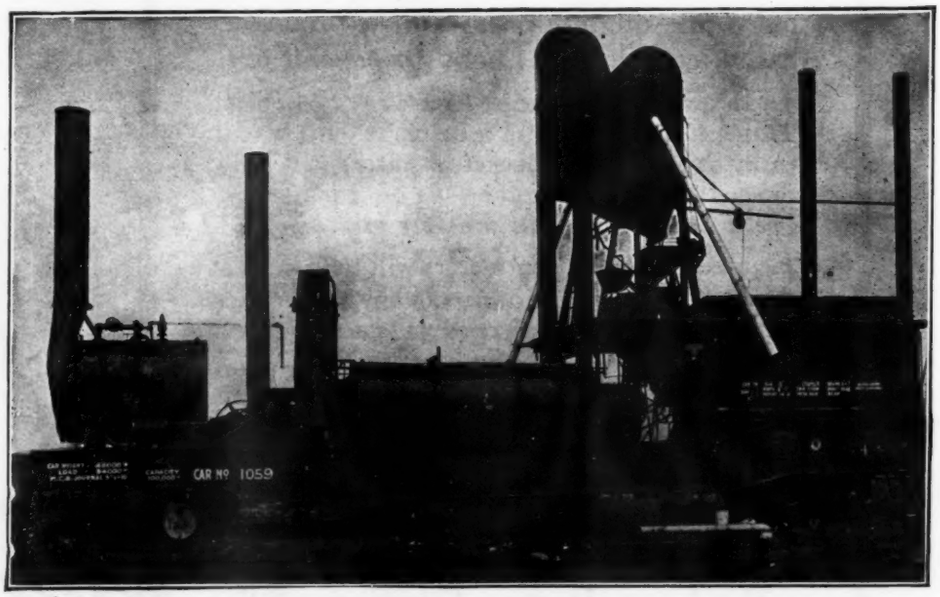

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FOR MUNICIPAL WATERWORKS, SEWAGE SYSTEMS, IRRIGATION PROJECTS and DRYDOCKS

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Sanitation-Geiger Gates, Valves and Control Apparatus
D'Olier Automatic Pumping Machinery and Ejectors
Sanitation-Geiger Water Screens
Larner-Johnson Valves

THE SANITATION CORPORATION

Engineers and Manufacturers

165 BROADWAY **NEW YORK CITY**

"Outlook" *says*

in issue of August 16, 1922

"—the farmer who has to drag his product through mud up to the hubs of his wagons pays, in time, loss of energy, and fatigue, a price fully equivalent to the cost of good roads."

WARRENITE-BITULITHIC PAVEMENT

is daily proving the folly of "dragging his product through mud up to the hubs" as well as the waste of other poor roads by providing rapid, easy means of transportation at costs surprisingly low, both for original installation and for upkeep year after year.

Our interesting booklets will give you surprising road information. May we send them to you?

Warren Brothers Company

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Carey Elastite

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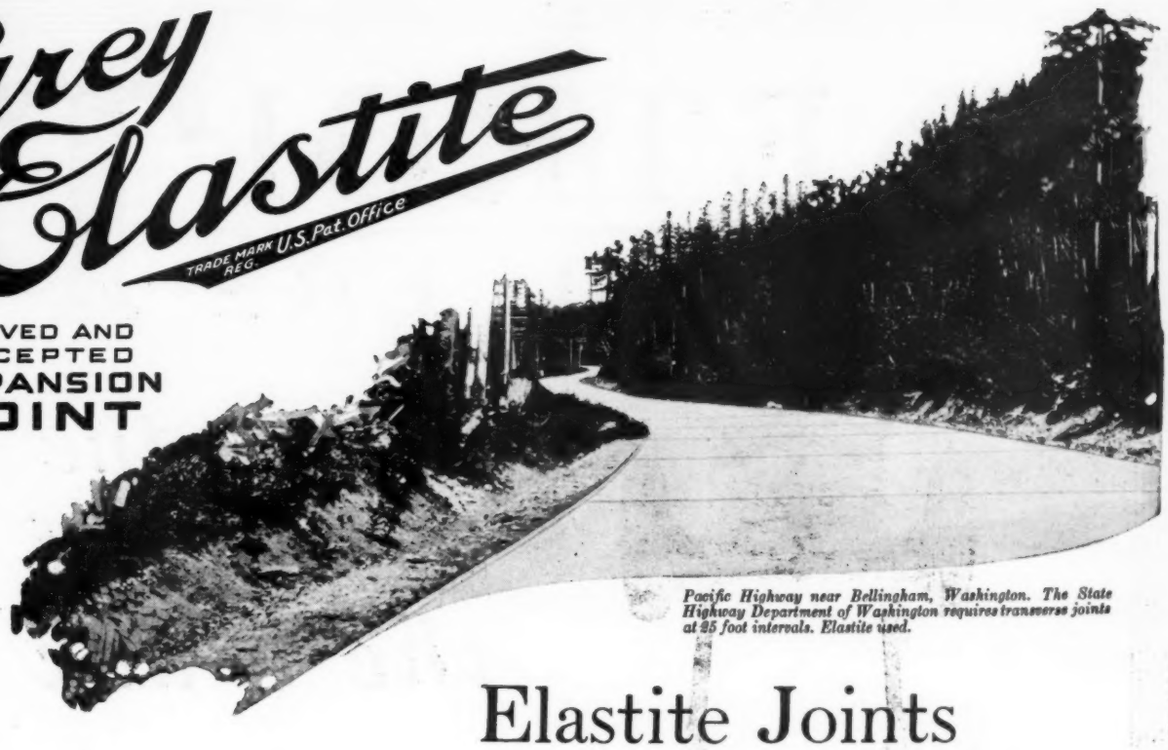
PROVED AND ACCEPTED EXPANSION JOINT



Pacific Highway near Bellingham, Washington. The State Highway Department of Washington requires transverse joints at 25 foot intervals. Elastite used.

Elastite Joints never need "re-pouring"

IT costs one county $20 a mile to *re-pour "poured joints."* This pouring must be done promptly as often as once a year if roads are to be kept in good condition, and to protect the sub-grade from water soaking and frost-injury.

Elastite joints never need "re-pouring" or re-placing. Elastite is a ready-made, frost-tight, water-tight, efficient, durable and permanent joint. Elastite does not melt, run out, or cut out with heavy traffic. The maintenance cost for Elastite is *zero.*

Elastite is a factory-made expansion joint, preformed and ready-to-use. It is a body of tempered asphalt compound sandwiched between two layers of asphalt-saturated felt, comes to the job cut to form, size and thickness, and is installed in one operation.

Use Elastite for concrete, brick and block pavements, sidewalks, flumes, aqueducts, bridges, viaducts, reservoirs, stadia and large buildings. Orders in any quantity shipped within 48 hours from stocks at the nearest of seventeen distributing cities in every section of the United States. Write for samples and information.

THE PHILIP CAREY COMPANY
10 Wayne Avenue, Lockland, Cincinnati, Ohio

Elastite has proved its efficiency, economy and serviceability in these important installations:

U. S. Marine Corps Roadway, Marine Barracks, Port Royal, S. C.
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Wisconsin State Highways
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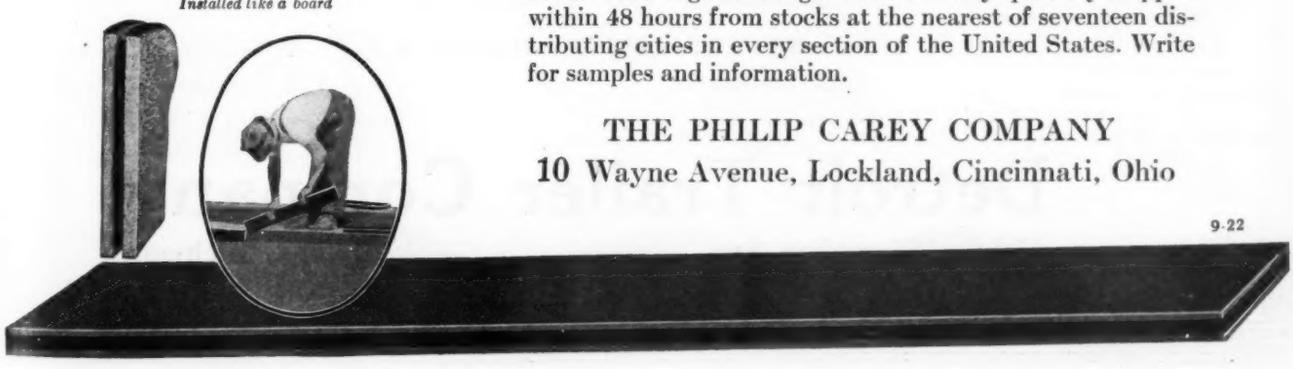
Missouri State Highways
Massachusetts State Highways
Connecticut State Highways
Kansas State Highways
Georgia State Highways
New Municipal Swimming Pool, Johnstown, Pa.
New Sewage Disposal Plant, Milwaukee, Wis.

Made like a sandwich
Installed like a board



9-22

DETROIT TRAILERS

Follow the true line of the truck

Wheels are never out of alignment

Detroit Trailers do not sway.

Connection is made instantly with truck. No time lost. No clevis bolts to poke through. No cotter pins to bother with. Knuckle type axles insure four point suspension at all times when backing up or when turning sharp corners. Extension draw bar is equipped with double acting springs, which absorb shocks and prolong life of truck and trailer.

The Detroit Trailer lock is housed in and is packed in grease. No dirt or grit can get on the inside.

MADE IN ONE OF THE LARGEST TRAILER PLANTS IN THE WORLD.

Let our engineers recommend a type to suit your requirements.

WATCH IT TRACK

SEE IT BACK

Detroit Trailer Company

954 E. Milwaukee Ave. Detroit, Michigan

Dallas makes her tax dollar do more

The "Caterpillar's" field of usefulness is by no means limited to road making. There is a "Caterpillar"* of size and capacity for every power need. On farm or ranch, in the mining, oil and lumber industries, for snow removal, and other civic work—wherever power and endurance are at a premium, the "Caterpillar"* has no real competitor.*

Dallas, Texas, after competitive demonstrations, bought three 5-ton "Caterpillars"* in June, 1921, for use in its street maintenance department. These machines proved so economical of time and labor that last April the City added another 5-ton and a 10-ton "Caterpillar"* to its fleet. City Engineer Fairtrace says: "Before we had "Caterpillar"* motorized outfits we could only smooth up our 300 miles of dirt and gravel streets once a year. *Now we are grading these same streets every six weeks, or eight times as often. And our yearly cost of street maintenance has not increased one penny."*

Hundreds of other progressive cities and towns throughout the country are using "Caterpillar"* power to reduce the cost of leveling and ditching streets and alleys, hauling materials, preparing park sites, removing snow, and doing belt work. Write for our booklet on the "Caterpillar"* in municipal service.

**There is but one "Caterpillar"—Holt builds it. The name was originated by this Company, and is our exclusive trade-mark registered in the U. S. Patent Office and in practically every country of the world.*

CATERPILLAR
Reg. U.S. Pat. Off.
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PEORIA, ILL.
STOCKTON, CALIF.

THE HOLT MANUFACTURING CO., *Inc.*, PEORIA, ILL.

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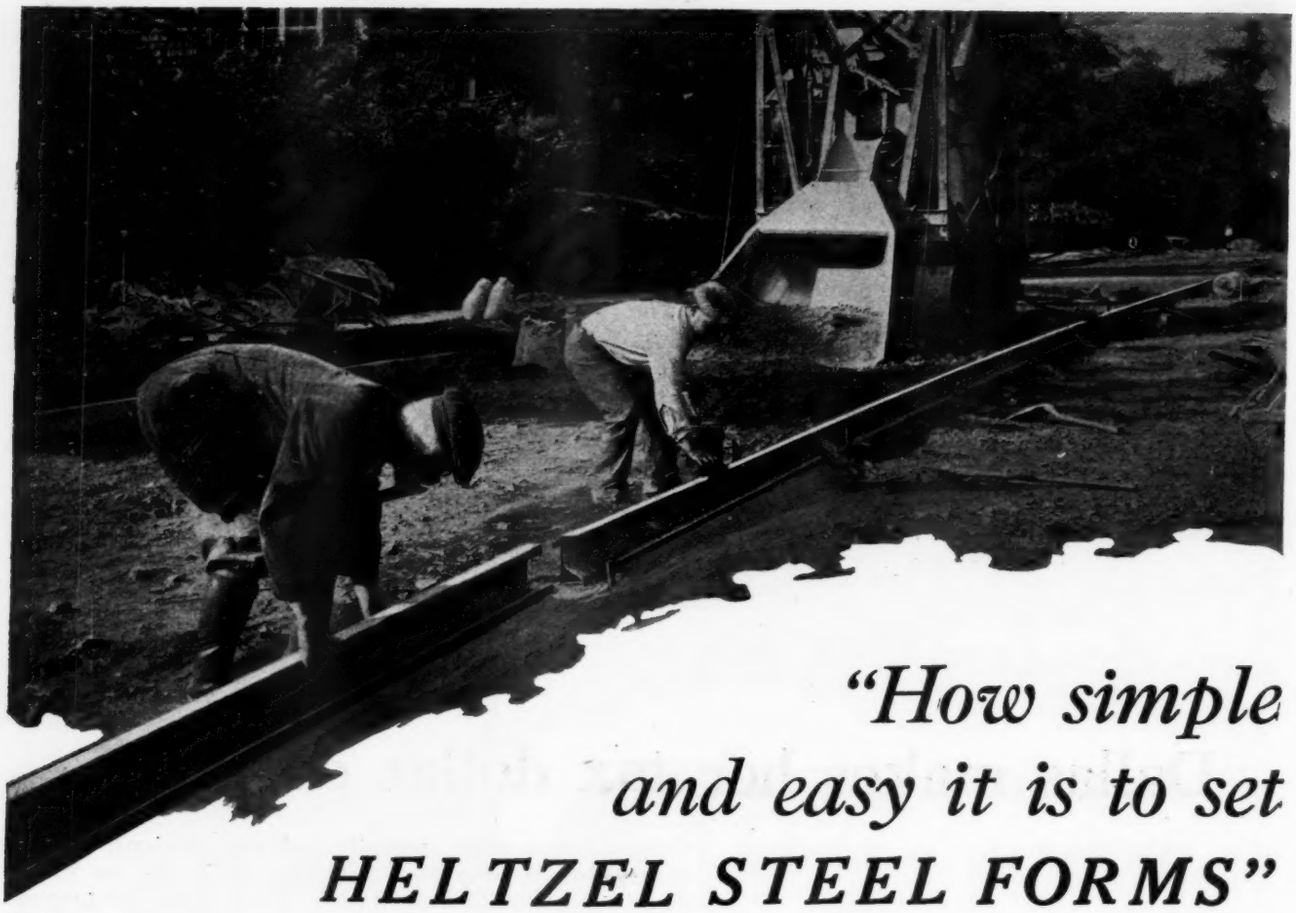

"How simple and easy it is to set
HELTZEL STEEL FORMS"

The simplicity of Heltzel Steel Forms, their great strength and the remarkable rapidity with which they can be handled have caused their adoption by road builders everywhere.

They are easy to set, take down and reset. They have made a big record for economy.

Heltzel forms are simple—just a rail that slips into a pedestal, held firm by a flat stake. Contractors use them over and over again for years.

Write for the Heltzel Blue Book which gives complete details

***The* Heltzel Steel Form & Iron Co.**
Warren, Ohio

HELTZEL STEEL FORMS
BUILT LIKE A RAILROAD

IF dependable, no-delay, never-quit mixer performance is the greatest profit factor you can put on the job—*as beyond question it is*—then the greatest value you can buy in a mixer is Koehring experienced engineering and Koehring heavy duty standards in design and construction—Koehring's downright refusal to compromise in any detail at your risk of time and profit losses.
KOEHRING CAPACITIES
Pavers: 7, 10, 14, 21, 32 cu. ft. capacities mixed concrete, steam and gasoline. Write for catalog P 14.
Construction Mixers: 10, 14, 21, 28 cu. ft. mixed concrete, steam and gasoline. Write for catalog C 14.
Dandie: A light staunch mixer for footings, culverts, foundations, etc. 4 and 7 cu. ft. mixed concrete, steam and gasoline. Power charging skip, low charging platform, batch hopper, light duty hoist. Write for catalog D 14
KOEHRING COMPANY
MILWAUKEE, WIS.
KOEHRING
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HEAVY DUTY

Stanolind

Paving Asphalt

The necessity of keeping the initial cost, as well as the upkeep expense, as low as possible in connection with such work is usually paramount. To those Park Boards who must maintain their own road building equipment,

Stanolind Paving Asphalt

will prove a wise selection because a minimum amount of equipment is necessary to lay it. Stanolind is equally satisfactory for walks as for roadways.

For Park Roads

Stanolind Paving Asphalt provides an ideal material for the construction of roads in parks and around important places of interest in the community. Roads so constructed harmonize well with all surroundings and form a noiseless, glareless surface which maintains the quiet atmosphere so desirable in such places.

A NEW BOOKLET RECENTLY ISSUED BY US TELLS THE LATEST METHODS OF CONSTRUCTING AND MAINTAINING BITUMINOUS PAVEMENTS. SENT FREE TO ENGINEERS AND COMMUNITY OFFICIALS WHO REQUEST IT ON THEIR OFFICIAL STATIONERY.

STANDARD OIL COMPANY

(INDIANA)

931 S. Michigan Avenue Chicago, Illinois

ANNOUNCEMENT OF
Prize Contest

Prizes:

FIRST PRIZE, $100.00 and a solid gold watch, 17 jewel, Waltham movement, case engraved with winner's name and standing in contest.

SECOND PRIZE, $50.00 and a solid gold watch, 17 jewel, Waltham movement, case engraved with winner's name.

THIRD PRIZE, $25.00 and a solid gold watch, 15 jewel, Waltham movement, case engraved with winner's name.

Fourth Prize.....	$20.00
Fifth Prize.....	$15.00
Sixth Prize.....	$10.00
Seventh Prize.....	$10.00
Eighth Prize.....	$10.00
Ninth Prize.....	$10.00
Tenth Prize.....	$10.00
Eleventh Prize to Twentieth Prize, inclusive, each...	$5.00

In addition to the above awards, $5.00 will be paid for each record that is published.

OBJECT OF CONTEST:

We are going to settle the question of how much it costs to keep up a well-built steam shovel.

Some steam shovel owners have said that manufacturers are optimistic in giving out their figures. The ERIE Steam Shovel Co. has always been ***conservative,*** over-cautious. Upkeep costs have in many cases been placed higher than we knew them to be—because we did not want the average shovel owner to expect unusual results from an average field organization.

Now, however, we are going to perform a service to the steam shovel owner by getting together many actual records, and publishing them in full detail.

To secure as many records as possible, we are offering prizes for the best reports giving ***low upkeep cost*** records made by ¾ cu. yd. shovels which have received good care. We are going to award 20 prizes ranging from a first prize of $100.00 and a good gold watch, down to $5.00, in addition to $5.00 for each record that is published. (See list of prizes, in upper left hand corner.)

In order to avoid comparisons which might reflect unfavorably upon other makes of steam shovels, it has been decided to limit the entries to ERIE Shovels only.

Judges:

The letters will be rated, and the prizes awarded, by the following board of judges:

ARTHUR S. BENT, of Bent Brothers, Los Angeles, Calif., pioneer contractors on large hydro-electric and irrigation project construction; President of the Associated General Contractors of America.

HALBERT P. GILLETTE, Editor of "Engineering and Contracting" magazine, and author of "Handbook of Cost Data," "Earth Work and Its Cost" and many other engineering works.

ARTHUR C. VICARY, Vice-president of the ERIE Steam Shovel Co.; mechanical engineer with many years of specialized experience on steam shovel work.

In making the awards, the judges will consider the actual record made by the shovel, and also interesting and informative details that are given in addition to the actual record. If two machines were to make exactly the same record, the more interesting and informative letter would be given the higher rating. Photographs also would be considered.

HOW TO ENTER THE CONTEST:

Records may be sent in by steam shovel owners, by managers, or any employee who is in direct contact with the shovel work—the superintendent, engineer, foreman, or steam shovel operator. But in every case there must be a written statement by the owner of the machine, to the effect that the figures submitted are correct to the best of his knowledge.

Not more than one letter can be entered from one concern. If two or more entries covering different machines are received from one company, the best letter sent in will be considered. Contest closes December 31, 1922.

INFORMATION TO BE GIVEN IN LETTER

(1) Approximate number of days worked by shovel since put into service.

(2) Approximate number of cubic yards of material handled—stating how much classified as earth, how much rock, how much shale, etc.

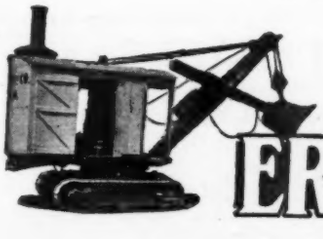
(3) Total amount spent for repair parts. (Do not include dipper teeth, hoisting cable, or grate bars, as these are wearing parts which need replacement on any shovel that is working, even when it receives the best possible care.)

(4) Total lost time, during which the work was delayed for repairs to shovel.

Besides the above information, any additional details of interest should be included—together with one or more photographs of the shovel in action, if available.

Address your letter to A. C. Vicary, Vice President, ERIE Steam Shovel Co., Erie, Pa.

If your firm does not own an ERIE and you cannot entire this contest, please refer this advertisement to someone who can act upon it. Thank you!



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CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

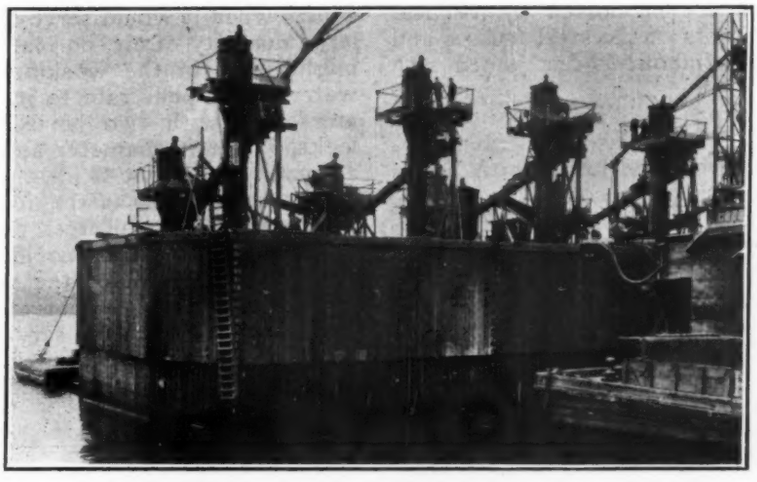
Vol. 53 November, 1922 No. 9

Delaware River Bridge Piers

Design of the river piers and their pneumatic caissons for the bridge between Philadelphia and Camden now under construction—the longest suspended span yet constructed.

The municipal bridge across the Delaware River at the foot of Race Street, Philadelphia, will extend from the foot of Race Street, Philadelphia, to Pearl Street, Camden, and will be built under the direction of the Joint Commission from the States of Pennsylvania and New Jersey and the supervision of a board of bridge engineers, of which Ralph Modjeski is chief engineer and George S. Webster and Lawrence A. Ball are consulting engineers.

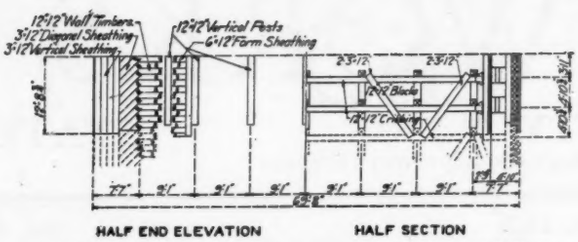
The bridge will include a suspended channel span of 1,750 feet, center to center of piers, and suspended side spans. It will have two decks and carry electric car tracks, two roadways and two sidewalks. The river span will be the longest of its kind yet built, exceeding by 150 feet that of the Williamsburg span, the longest yet completed.



PIER A CAISSON AND EQUIPMENT.

The river piers, 1,750 feet apart on centers, have their foundations carried through mud, sand and gravel, to bearing on bed rock at a maximum depth of about 86 feet below datum, which is about 2.43 feet below mean high water. The top of the pier is I-shape in plan with a maximum width of 40 feet, minimum width of 14 feet and length of 105 feet, having at each end large bearings for the bases of the steel towers, which are 27.75 feet above datum. The sides and rounded ends of the piers are battered 1:24 and are faced with cut granite to an elevation below water level. The foundations of the piers were built in pneumatic caissons, 69 feet, 8 inches wide and 143 feet long over all, which, with their fixed and movable cofferdams, had a total maximum height of about 74 feet. The piers and their foundations are constructed of 1:2:4 concrete, having a required strength of at least 2,000 pounds per square inch, and 1:2½:5 concrete, having a specified strength of 1,600 pounds when 28 days old.

The caissons, 69 feet, 8 inches wide and 143 feet long over all, and 43 feet high from the cutting edge to the tops of the permanent cofferdams, were built with a steel working chamber 8 feet, 2 inches in height, having vertical walls continuous with the solid walls of the permanent cofferdams, made with 12x12-inch timbers with vertical and diagonal outside 3x12-



DETACHABLE COFFERDAM FOR PNEUMATIC CAISSONS.

inch sheeting and with connections at the top for securing the detachable cofferdams of similar construction, which reach above water level.

The roof of each cassion was supported by four transverse solid timber bulkheads 36 inches thick, made up of 12x12-inch yellow pine timbers that were intended to serve only as intermediate supports for the steel roof and the pier above it. The bulkheads are each made with two 3x4-foot openings to provide communication between the adjacent compartments of the working chamber. The steel cutting edge is heavily reinforced.

There are seven longitudinal riveted steel trusses with their lower flanges riveted to the steel plate roof of the working chamber and their ends riveted to pairs of vertical 12-inch channels secured by flange bolts 24 inches apart to the timber walls of the caisson and cofferdam. Above the trusses ,the caisson was braced with horizontal 12x12-foot transverse and longitudinal timbers in the plane of the trusses, which, like the latter, divided the interior of the caisson into panels 9 feet 1 inch by 9 feet 10 inches on centers. The timbers are supported by vertical posts at the panel points of the steel trusses and are made in lengths of about 30 feet joined with steel fish plates.

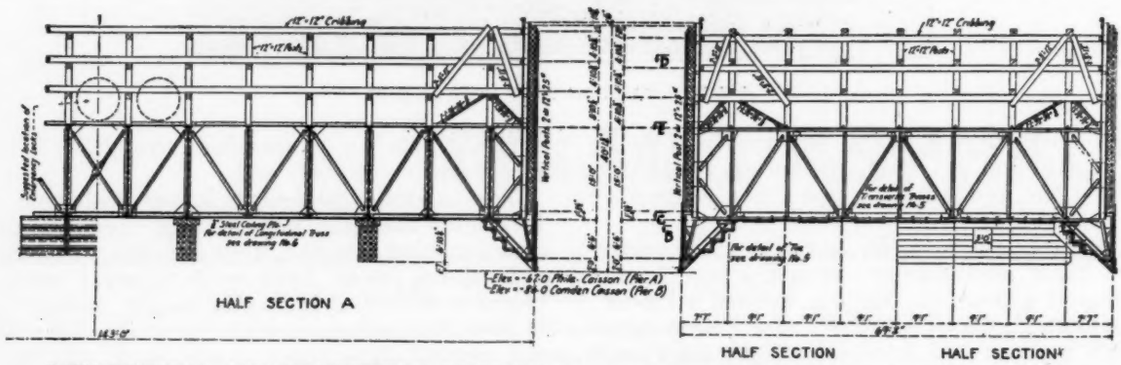
Similar bracing is provided for the removable cofferdam on top of the caisson, which is detachably connected with the latter with hooks and wedges. The detachable cofferdam for the Philadelphia pier was 12 feet high and the ends of its two piers of horizontal bracings took bearing through large steel U plates bolted to the vertical members of the cofferdam. Each side of the cofferdam consisted of three detachable panels connected at the corners to the adjacent panel with bolts. As the pier shaft is narrower than the foundation, the cofferdam was offset about 3 feet on each of the long sides from the faces of the caisson wall, the spans being covered by a solid timber deck, 12 inches thick.

Great pains were taken by the engineers and contractors to make every possible provision for the safety of the workmen, to insure the rapid and economic placing of the concrete, and that it should form a solid mass completely filling the caisson and leaving no holes or air spaces in it or in the cofferdam itself.

All of the muck is removed through 10 vertical shafts, 3 feet in diameter, surmounted by Mattson air locks, which were equipped with cylindrical buckets hoisted by wire cables, passing through stuffing boxes in the tops of the locks and then over guide sheaves to two-drum Lidgerwood engines. The locks were provided with side doors, through which the buckets were tilted to empty into wooden chutes with their lower ends projecting beyond the outside of the cofferdam so as to discharge into scows alongside, which were towed away and dumped. The same vertical shafts were used for filling the working chamber with concrete.

A 4-foot vertical shaft, provided with an elevator hoist and an air lock, was installed for the use of the workmen and there was also built, not much above the roof of the working chamber, a long refuge chamber 7 feet high in the solid concrete filling of the caisson and communicating through open hatches with vertical ladders to each of the five main compartments of the working chamber. This refuge chamber or "tunnel," as it was called on the work, was intended to safeguard the men in case of emergency, when it would serve as a trap to retain a large quantity of air, no matter what conditions might exist in the working chamber or what water might penetrate to it. This tunnel communicated with two horizontol cylindrical air locks, 7 feet in diameter and 15 feet long with a capacity for about 40 men, which were installed at the same level at the foot of an open well having walls of reinforced concrete 5 feet thick and containing stairs providing ample exits for the workmen. All of the vertical steel shafts were provided with horizontal hinged doors, kept closed when not in service. The tops of the shafts are always maintained above water level.

Each manlock was provided with a special re-



LONGITUDINAL AND TRANSVERSE SECTIONS OF PNEUMATIC CAISSON FOR RIVER PIERS. DETACHABLE COFFERDAM NOT SHOWN.

TRANSVERSE BULKHEADS FOR WORKING CHAMBER OF CAISSON.

cording air guage, showing the amount and change of air pressure in the air lock within any five minutes. The guages were kept in locked, waterproof boxes and were frequently tested and maintained in accurate working order. Compressed air was supplied to each of the five main compartments of the working chamber through two 6-inch and two 4-inch pipes. The air supply pipes were fitted with a lock valve besides having an automatic enclosed check valve. When the men were in the working chamber, air was supplied to it through the two separate lines of piping, which were also connected to the refuge chamber. A pulsometer was also installed in each corner of the caisson to remove all leakage, but the caisson has proved to be so tight that little service has been required of them.

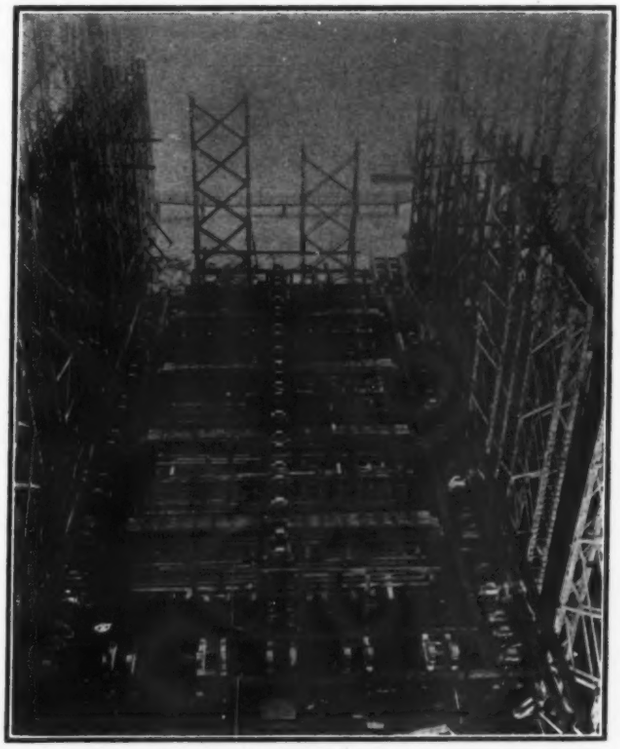
M. E. Case is resident engineer for the Delaware River Bridge Joint Commission, D. A. Hughes is superintendent of construction, S. M. Swaab is chief engineer of the Keystone State Construction Company, and Carleton Greene is engineer for Holcombe, Cabot & Rollins.

BUILDING AND LAUNCHING CAISSONS

The two 143x70x43-foot steel and wood pneumatic caissons for the river piers of the bridge were built on covered ways of the New York Shipbuilding Company at Camden, New Jersey, by the shipbuilding company as subcontractor. Each caisson has a working chamber 8 feet 6 inches high with steel plate walls and roof surmounted by solid timber walls 12 inches thick, braced by 21 longitudinal and transverse riveted steel trusses 15 feet deep and by three tiers of 12x12-inch horizontal transverse and longitudinal struts above the trusses. The roof of the working chamber is supported by the steel wall and cutting edge and intermediately by four solid longitudinal bulkheads three feet thick.

The caissons were built with their longitudinal axes perpendicular to the shore line and with the cutting edge and transverse bulkheads supported on two regular ship ways inclined ⅞ inch in 12 inches. These ways were installed in covered slips equipped with plate girder electric traveling cranes of 50 and 100 tons capacity that run from end to end of the ways on tracks at two different levels enabling the cranes to pass under and over each other. These cranes handled all of the material required in the caisson construction and were supplemented by a complete line of pneumatic tools for boring, drilling, riveting, and caulking, which eliminated a large amount of hand work and expedited the construction of the caisson.

The transverse bulkheads, 7 feet high, 10 feet thick and about 55 feet long, weighing 84 tons each, were assembled and bolted together complete in the shipyards and then, as units, were set in place on the ways by the 100-ton crane. Falsework was built parallel to them to support the steel plate roof of the working chamber, which was assembled on blocking about four feet above the top of the bulkheads so as to give clearance for convenience in riveting. The steel cutting edge, roof and sidewalls were assembled in position and riveted complete, while the transverse trusses were assembled and riveted up and set in position on the steel roof by the traveling crane. The longitudinal trusses were delivered in separate pieces and short sections were assembled to the transverse trusses after the latter were in position. After the completion of the stiffening trusses, solid courses of 12x12-inch wall timbers and the two courses of vertical and diagonal sheathing planks were bolted on, all of the timbers being dressed accurately to dimensions one-quarter inch less than nominal. All boring was done with pneumatic tools and rivets were driven by pneumatic riveting guns. Seven gangs of riveters were employed on the trusses and steel roof. The outside



BULKHEADS ON WAYS. BLOCKING READY TO SUPPORT STEEL ROOF.

course of sheeting was caulked with oakum.

All of the horizontal timber braces for the second caisson were cut, assembled in the yard, match-marked, holes drilled, taken apart and reassembled in the caisson.

After the rivets in the steel walls and roof were driven they were tested in the usual manner by tapping with hammers to detect any loose rivets. The workmanship was of high class, and the riveting and caulking were so good that very few leaks developed when the caissons were launched.

After the completion of the steel work, the four 84-ton timber bulkheads were hoisted 4 feet and pulled up against the underside of the roof by tackles suspended from the overhead traveling crane, which held them in position until they were securely bolted permanently. The weight of the caisson was then transferred from the blocking to the pair of ship ways, and, in order to protect the edges of the working chamber walls and the bulkheads from violent impact with the water, they were covered with temporary bottoms of longitudinal planks 3 inches thick reaching from bulkhead to bulkhead and from bulkhead to cutting edge. The planks were assembled loose, not bolted to the caissons, and were temporarily held in position by wire slings passing up through the interior of the caisson and made fast in the upper portion.

The caissons were launched on the ship ways by cutting through the two timbers that locked them into position. The inclination of the ways sufficed for the automatic launching without requiring the assistance of the two 75-ton jacks that had been provided for use if necessary.

Water rapidly entered through the false bottom, which was not intended to exclude it, and the bottom was promptly removed, after launching, by detaching the wire cables that held up the loose planks very much in the manner that a venetian shade is operated, and thus the planks were disengaged from their bearings, floated to the surface and recovered.

The building of the first caisson was executed with double shifts. It was towed with the tide 5 miles to position at the Pennsyvania side of the river at the foot of Race street, being handled by one tug in front and one on each side. It made the trip in about one hour, and was securely fastened to piers No. 7, 9 and 13, accurately locating it in the position in which it was sunk.

The two caissons are substantially duplicates and were successfully sunk in the same manner and by practically the same plant to bearing on solid rock at depths of approximately 60½ feet and 84½ feet, respectively. The Pennsylvania pier, known as Pier A, was built and launched before Pier B was commenced, and it was towed to position May 1; sinking was commenced by the deposition of concrete May 9 and was completed July 9. It is expected that Pier A will be completed about December 15, 1922. The caisson for Pier B was launched July 18.

The contract for the piers was awarded on December 27, 1921, to Holbrook, Cabot and Rollins.

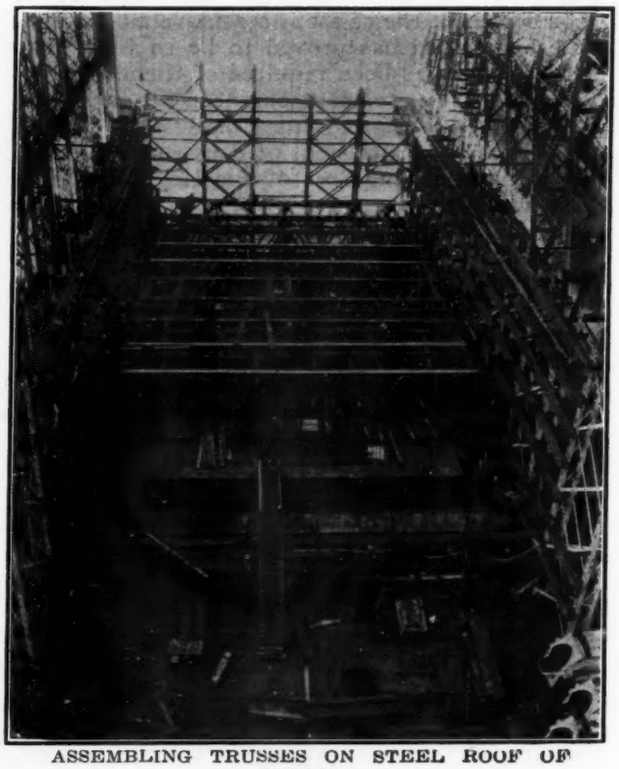
OLD COMMERCIAL PIER UTILIZED

The axis of the bridge is perpendicular to the bulkhead line, on which the river edge of Pier A is located at the foot of the existing Pier 11, which has been used for commercial purposes and will eventually be entirely removed to clear the bridge structure. During preliminary construction operations the pier has been utilized by the contractor for storage, office, shop and construction purposes, affording excellent provision for the delivery and installation of plant equipment and materials and shelter for the officers, men's quarters and some of the required supplies.

The pier was originally 60 feet wide and 540 feet long, with water 35 feet deep at the outer end. It was of pile construction covered by a wooden shed. About 60 feet of the river end was removed to clear the caisson, which was securely moored to it and to the ends of the adjacent piers 10 and 12. The river here is subject to an average tidal rise and fall of about 5 feet, and, as conditions did not require the construction of protecting works around the caisson, ample space was available in the slips and at the end of the pier for mooring scows, derrick boats and other floating equipment used in pier construction.

After removing the end of the pier shed and pulling the piles on which it was supported, the contractor removed about 20 feet more of the pier shed and an additional 40 feet of the pier roof, temporarily leaving the remainder of the building substantially intact, and affording space for the installation at the extreme end of the pier of two Ransome steel concrete hoisting towers 105 feet high, each of them equipped with a one-yard hoisting bucket, a vertically adjustable hopper, a steel boom 80 feet long, and a counter-weight truss 60 feet long supporting a steel chute 40 feet long connected with another chute supported by the boom and reaching to the concrete hopper.

Immediately in the rear of the hoisting towers

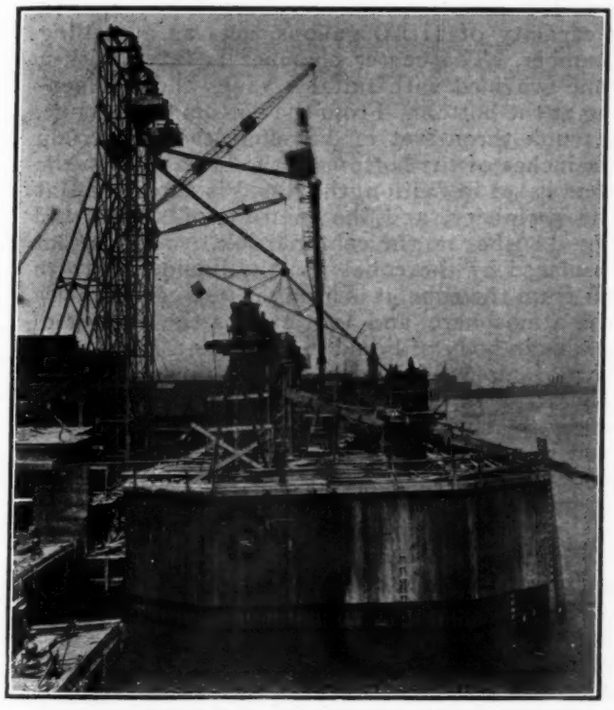


ASSEMBLING TRUSSES ON STEEL ROOF OF CAISSON.

were erected storage bins for aggregate, having a capacity which, because of the limited space available, was only about 200 yards. These bins were supported above the original roof level on wooden derricks mounted above the existing roof at the rear of the bins, and supported on timber towers built outside of the old shed, thus giving the derricks command of the storage bins and of the sand and stone barges brought alongside.

MIXING AND POWER PLANTS

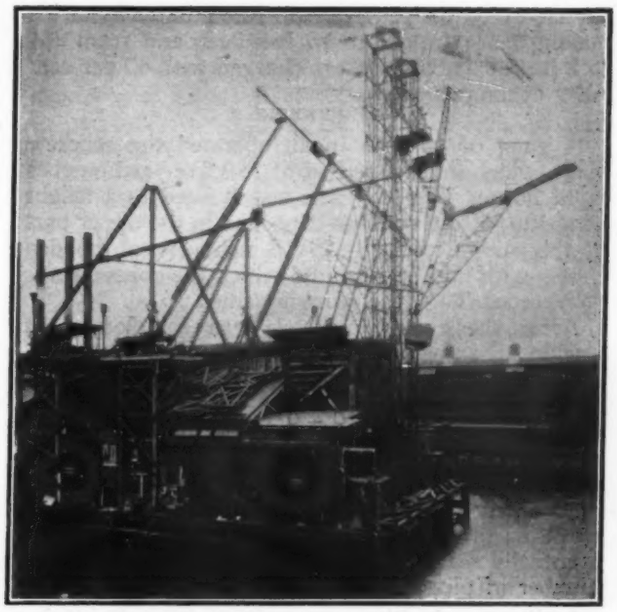
The mixing plant, consisting of two 32-foot Ransome machines, was installed directly under the storage bins, each supplied by gravity and discharging through a short chute into the buckets in the hoisting towers. Immediately adjacent to the mixing plant on the land side of the pier was located the 18x80-foot cement storage in which there is



SINKING AND CONCRETING CAISSON FOR PIER A.

maintained a liberal supply in bags delivered in trucks on the pier and transferred from the land end of the pier to the storage room by a long belt conveyor. Adjacent to the cement storage room is the power room, in which there are installed five straight line and one duplex Ingersoll-Rand air compressors with a united capacity of 5,500 cubic feet of free air per minute, which provide the low pressure air for the caisson and air at 100 pounds for operating pneumatic tools, and include three compressors held in reserve for emergencies or excess demand.

On account of the comparatively low pressure required it was not necessary to install any refrigerating device to cool the air in the working chamber. In the land end of the compressor room there was installed a battery of six 100-H.P. horizontal boilers with a 6-inch Cameron steam pump. Opposite the boiler room are the contractor's offices and rest



HOISTING TOWER, AGGREGATE STORAGE AND CONTRACTOR'S PLANT AT PIER 11.

rooms, and on the upper floor, over the air compressors and cement storage, are large lavatories and dressing rooms for the sand hogs, rest room, eleven shower baths, and the doctor's office and waiting room.

CAISSON SINKING

In sinking caisson A, the action of the tide at the end of Pier 11 forced the caisson about 12 inches out of plumb at the outset, but subsequent efforts reduced this amount to 9 inches when the caisson was landed on rock. When the caisson was first landed on the river bed, one end in soft mud sank about 3 feet deeper than the other end, but after the caisson was sealed and air pumped in the high end was sunk down to the same level as the low end, and uniform excavation was continued by the ordinary pick and shovel method, delivering the muck to cylindrical buckets at the foot of the material shafts, two in each compartment. The bucket lines ran through stuffing boxes in the tops of the Mattson material locks, and when the locks were opened the buckets tilted and dumped their contents through wooden chutes into dump scows alongside. The tops of the air locks were about 84 feet above the cutting edge on the shore side of the caisson and about 72 feet above the cutting edge on the river side, thus providing sufficient clearance for the required slope of the chute and clearance for the dump scows.

The caisson work was done by a total force of about 400 sand hogs in six-man gangs working 3-hour shifts with an interval of 3 hours between shifts, so that the work progressed continuously, each man working six hours out of twenty-four for a flat rate of $7.50 per day. The maximum progress was 28 inches in 24 hours, requiring the removal of 925 yards of sand and gravel. The caisson was sunk through mud, sand and gravel and 10 feet through loose rock, which was penetrated at the rate of about 9 inches in 24 hours, the rock being drilled

by a battery of 15 Ingersoll-Rand butterfly drills making holes from 3 to 16 feet deep and from 2½ to 5 feet apart, which were charged with 40 per cent Atlas dynamite.

CONCRETING

A gang of 14 men in all operated the concrete plant, which made a record of 599 five-yard batches in 12 hours. The concrete was hoisted to a height of about 86 feet and was deposited in the upper part of the caisson through 18x18-inch vertical wooden chutes with hopper tops into which the concrete was delivered through the swinging chutes.

After the excavation had been completed, the working chamber was filled with concrete delivered through the ten material shafts. Special concreting locks were placed on top of the material locks and both valves of the latter were left open to permit the rapid delivery of the concrete. The locations of the shafts were such as to permit the placing and flow of concrete by gravity and almost eliminated hand work in filling the working chamber, which was eventually sealed by grout forced in through a large number of pipes distributed over the entire area of the caisson so as to insure filling all voids left in the upper part of the concrete. After the working chamber had been filled, the refuge chamber or "tunnel" was filled with concrete deposited through eleven 12-inch vertical filling pipes arranged to command all parts of the interior and provide for the automatic deposition of the concrete without hand work in spreading. The upper portions of all the air shafts were sheeted in, to permit their removal after the lower part of the caisson had been completed, thus leaving wells which will eventually be concreted solid.

WELFARE AND SAFETY PROVISIONS

Although the maximum pressure in the working chamber of caisson A was only about 28½ pounds, great precautions were taken for the welfare of the sand hogs, which were so successful that no fatalities and very few serious cases of bends occurred. The lower ends of all air shafts were provided with hinged horizontal steel doors which were kept nearly closed when not in use; air was supplied through several independent mains, furnished by compressors operated by independent power supplies, and each main was provided with an automatic flap valve and a pressure regulating valve and pressure gauge.

The contractor provided comfortable and spacious resting rooms with individual lockers, hot and cold water and sanitation, in charge of an attendant, and supplied heat, light, ventilation and hot coffee for the men. He also maintained a separate hospital room for each pier, which was provided with a 6x24-foot field hospital lock having two compartments and with a capacity of about 12 men each. The locks were under the supervision of an experienced physician and the hospital was well equipped. All the compressed air employees were subject to examination and approval when they commenced work and every three months thereafter while working in the contractor's employ and after each return from an absence of one month or more. All employees in the compressed air were furnished with badges giving directions that in case of being stricken while off duty they were to be rushed to the hospital at the works rather than to a public hospital.

Aeration Experiments in England

The manager of the sewage works at Bury, England, J. Bolton, describes some experiments on aeration in the "Surveyor" of London. His article is abstracted as follows by Rudolph E. Thompson in the "Public Health Engineering Abstracts":

Preliminary settling and equalizing tanks are considered necessary for sewage containing trade wastes. The last tank put down by the corporation of Bury is dealing with tank effluent after nine hours' sedimentation. The tank is 24 feet in diameter, provided with a coned bottom, the depth to the bottom of the cone being 18 feet. An inner division is constructed of light timber, 19 feet in diameter, and carried 10.5 feet below top water level. The inner compartment, which has a capacity of 32,700 gallons, acts as the aerating chamber, and the outer chamber, with a capacity of 11,300 gallons, acts as a settling chamber. The center chamber is fitted with a cone provided with suitable vanes and an opening at the bottom. From the bottom of the cone, a trunk three feet in diameter leads to within six inches of the bottom of the tank. When the cone is set in motion, the liquid is thrown off at the periphery, and the mixture of sludge and liquid rushes up the center trunk to replace that displaced by the cone. As the liquid is thrown off from the cone, it is brought into contact with the atmosphere, and as it strikes the surface of the main body of liquid in the tank a large number of air bubbles are carried down into the liquid; by this means sufficient oxygen is taken up by the sludge to keep it in an active condition and bring about the required purification. The cone liquid strikes the surface of the tank liquid in such a manner that a circular motion is set up in the tank causing the sludge to descend in the form of a spiral, thus ensuring a longer contact and avoiding short circuits.

This system of combined aeration and settling tank has the advantage of saving the power required for re-circulating the sludge. One disadvantage, however, is that the operation of the tank has to be suspended for about 15 minutes daily to allow the surplus sludge to consolidate before being drawn off, otherwise a very watery sludge is obtained. The power used at present is less than 15-h.p. per million gallons per day. The following are average results of analyses, in grains per gallon:

	Settled Sewage	Effluent	Purification
Oxygen absorbed, 3 min.. ..	1.34	0.30	77.6%
4 hours ...	3.98	0.71	82.2%
Ammonia—Free and Saline..	2.10	1.60	23.8%
Albuminoid	0.52	0.09	82.7%
Chlorine	6.20	6.10	.....
Solids in suspension.....	3.20	traces	.....
Dissolved oxygen taken up in 5 days	...	0.63	.....

At times rapid changes take place in the character and bulk of the sludge. Sometimes an increase of over 5% in a day is obtained with the top portion of the sludge having a grayish cast. On such occasions, microscopic examination shows the sludge to be teeming with higher

forms of life, particularly vorticella, which appear in countless millions and at times come over with the effluent. When these conditions occur the sludge has a high water content. In ordinary practice, sludge has been drawn off with a water content as low as 97%, but when the sludge begins to increase in volume the water content is as high as 99%, and the nitrogen content of the dried sludge increases to as much as 8%.

Treatment of Sewage Sludge

How forty-three of the larger cities dispose of their sludge. Three sell it to farmers. Analyses of sludges classified by kind of tank used. Details of plants.

The nature and disposal of sewage sludges, as determined by a questionnaire of United States cities, was presented in a report before the American Society for Municipal Improvements and also before the American Public Health Association by committees of those two societies of which Langdon Pearse was chairman in each case.

Although an effort was made to obtain data from all towns of more than 1500 population, this was found impracticable and attention was concentrated on those having 25,000 population and more, and data are still lacking from a few of these. Sewage treatment works were found in seventeen cities of 100,000 population and up and in twenty-six cities of 25,000 to 100,000. The total population in the former group of cities was a little under 9 million, and in the second group of twenty-six cities was a little under 1¼ million. In addition to these, three cities coming in the former group and two in the latter have sewage treatment works under construction.

Answers to one inquiry were to the effect that of the group of larger cities practically no complaints are made against the operation of any of the plants except that of Baltimore, as regards either the plant itself or the disposal of sludge; while among the smaller cities, the Schenectady, New Britain, Fresno and Plainfield plants have been the cause of some complaint, and that at Austin before covering the tanks and trapping the sewer outlet, but no complaints have been caused by plants in the other cities.

DISPOSAL OF SLUDGE

Apparently all of the cities having air-dried sludge dump it on land, except Cleveland, Providence, Madison, Fresno, Mansfield and Plainfield. Only two, and those among the larger cities, have actually tried heat drying. Cleveland dumps liquid sludge into Lake Erie, while Providence dumps it at sea. The sludge is lagooned by Columbus, Worcester, San Antonio, Houston, Reading and Madison. Liquid sludge is plowed into the ground by Atlanta, Fresno, Fitchburg, Madison, Mansfield and Plainfield. Sludge is discharged into the river as opportunity offers by Columbus, Akron, Atlanta, Houston and Schenectady.

Removal of the sludge by farmers is reported by Philadelphia, Baltimore, Rochester, Columbus and Atlanta, and small amounts by Providence and Worcester. The same farmers have used sludge for several years in succession at Philadelphia, Rochester, Columbus and Atlanta, and to a certain extent at Baltimore and Worcester. Of these only Baltimore and Rochester report receiving money for the sludge, the former 25c per load and the latter 75c per load of two cubic yards. Baltimore, however, has received from $374 to $2,690 per year from the sale of sludge to a fertilizer company as well as to farmers. Of the smaller cities, Canton, Brockton, Lexington, Fitchburg, Pontiac and Mansfield report removal by farmers, and Allentown and Plainfield to a certain extent. The only one of these reporting sale of sludge is Pontiac, where two dollars per cubic yard is received. Plainfield reports that the sludge grows good corn, but its use is handicapped by the grease.

The analyses of the sludges were reported by a number of cities and the following are the averages of the figures reported:

Specific gravity, 1.03 for the larger cities and 1.02 for the smaller; figured on a dry basis, the larger cities show a moisture content of 87% and the smaller cities, 93%; voltatile matter, 46% in the larger cities and 45% in the smaller, and fixed matter, 54% in the larger and 55% in the smaller.

Nitrogen averages, 1.93 for the larger and 1.63 for the smaller, while ether soluble averages 8.4 for the larger and 8.2 for the smaller.

The above does not include the activated sludge plants, for which plants (those at Worcester and Houston), the specific gravity averages 1.03, moisture content 98.8, volatile matter 63 and fixed matter 37, nitrogen 5.5% and ether soluble 7.7%. The accompanying table gives the analyses of sludges received from the several sewage treatment works, all made on a dry basis in the laboratory of the Sanitary District of Chicago.

Analyses of Sludges Received from Sewage Treatment Works
All analyses on dry basis per cent.

Source of sludge	Nitrogen	Grease	Volatile matter (organic)	Fixed matter (inorganic)	Nitrogen in volatile matter
IMHOFF TANK					
Fitchburg, Mass.	1.71	4.6	35.3	64.7	4.84
Columbus, Ohio	2.04	5.5	45.7	54.3	4.46
Batavia, N. Y.	2.93	3.1	47.0	53.0	6.23
Plainfield, N. J.	2.91	4.1	50.7	49.3	5.74
Cleveland, Ohio	2.40	1.6	40.3	59.7	5.95
Atlanta, Ga.	1.37	4.8	34.1	65.9	4.02
Average	2.23	4.0	42.2	57.8	5.28
SECONDARY TANKS RECEIVING EFFLUENT OF SPRINKLING FILTERS					
Fitchburg, Mass.	2.25	4.6	43.4	56.6	5.18
Plainfield, N. J.	3.78	2.6	57.6	42.4	6.56
Average	3.02	3.6	50.5	49.5	5.87

CHEMICAL PRECIPITATION					
Worcester, Mass.	1.62	1.2	41.8	58.2	3.88
ACTIVATED SLUDGE					
(Sewage)					
Milwaukee, Wis.	5.82	2.2	67.8	32.2	8.58
Houston, Tex.	4.64	7.1	62.9	37.1	7.38
Average	5.23	4.6	65.3	34.7	7.98
(Industrial wastes)					
Argo, Corn Products.	6.03	1.2	75.3	24.7	8.00
Chicago, tannery wastes	2.18	0.2	49.4	50.6	4.41
Chicago, Stockyards testing station.....	4.17	6.0	62.6	37.4	6.66

NOTE: All these analyses were made in the laboratory of the Sanitary District of Chicago.

"The results of the inquiry show that the plants in the cities of 100,000 and upwards in general have technical attention and in most cases a chemist in charge, even though money is not always available for continued or complete operation. In the cities of from 25,000 to 100,000 only six have any complete control. Among the most thoroughly operated appear Fitchburg and Plainfield. The rest may have some control by a city official, but not enough to keep any real operating data. One city frankly reports no funds.

"From the standpoint of sludge disposal and use, the very great preponderance of air drying and dumping as a means of disposal is of note. Further, the lack of interest by farmers and the general lack of income as yet from sludge disposal are noteworthy. For this the low nitrogen content generally prevalent may be responsible. However, there is the possibility of lack of publicity. With suitable publicity one of the smaller towns within forty miles of Chicago has been selling its Imhoff sludge for several years at $5.00 per load. Chemical precipitation sludge appears to have practically no value.

"The obvious step necessary to interest the farmer in sludge is the development of a real yardstick of value. For this end the need of intelligent treatment on experimental farms is urged. At the suggestion of Mr. Hatton, the secretary of the U. S. Dept. of Agriculture has been requested by various municipalities to allocate part of the budget of his department for a thorough investigation, trying sludges in different parts of the country and in different crops. The experiment stations of the States of Illinois and Wisconsin have been urged by the Sanitary District of Chicago and the Milwaukee Sewerage Commission to cooperate. They have expressed a desire to do so within the limits of their resources. Further, the Sanitary District of Chicago is planning to undertake some experimental work in the vicinity of the truck farms around Chicago.

"In order to determine all the elements of value, trials extending over several years will be needed. Such trials to be effective necessarily must be quantitative. To properly apply the fertilizer and learn its true value, such trials should be under the direction of trained agricultural experts who know what fertilizers and what amounts are requisite for the different trial crops. Dr. Schreiner, of the Bureau of Soil Fertility of the U. S. Dept. of Agriculture, recommends trial crops typical respectively of roots, grain, leaf and fruit."

PLANT DETAILS

An inspection of the tabulated data shows that bar screens are used by twenty of the twenty-six plants in the group of larger cities and by eleven of the twenty-four plants of the smaller ones. Fine screens, two of 1/16" slots and one of 1/8" slots are found in three of the larger cities and four in the smaller. One mesh screen is recorded in the smaller cities.

In the matter of tanks, fourteen Imhoff tanks are found in the larger cities and twelve in the smaller; three activated sludge tanks in the larger; two septic tanks in the larger and two in the smaller; two sedimentation tanks in each group; one hydraulytic tank in the larger; one digestion tank in the smaller, and two chemical precipitation tanks in the larger. Filters are found for treating tank effluents in eleven plants of the larger cities and fourteen of the smaller; of these, trickling filters are found in ten of the larger and nine of the smaller; contact filters in one of the larger and two of the smaller; sand filters in two of the smaller and irrigation on land in one. In addition to these, one of the smaller cities has a plant for electrolytic treatment, one uses chlorination only in addition to fine screening, and one chlorinates Imhoff effluent.

Sewage Treatment at Johannesburg

The treatment of sewage at Johannesburg, Africa, contains a number of interesting features which are described by the city engineer, G. S. Burt-Andrews in "The Surveyor" of London for June 2nd. Some of the more interesting details are abstracted below.

The house sewage is carried in separate sewers, and in streets where there are storm sewers, these are placed above the sanitary sewers and in the same trench. Night soil from about 33,000 pail closets is dumped into the sewers which probably accounts for the unusual strength of the sewage. Comparing this with the sewage of the average English sewers, the suspended solids are more than seven times as high in parts per hundred thousand, the chlorine about two and one-half times as high and the nitrogen about three and one-half times.

The disposal plant consists of small silt basins or pits, coarse screens, large silt basins, four sedimentation tanks and an irrigation field.

In using the four sedimentation tanks the most satisfactory results have been obtained by operating the first two tanks in parallel and the second two in series. From the tanks the sewage flows upon an area of about 790 acres. A part of the farm has been underdrained for special use during wet weather. During dry weather, however, there is no visible effuent, which is accounted for by the high evaporation and the porous nature of the soil.

The sludge and screenings are removed by farmers to be used for fertilizer. Rye grass is grown on a considerable part of the irrigation

field with good success. Farmers are permitted to graze their cattle on the field, a charge being made of four pence per head per day. During 1921 the total amount obtained from this source was 3,141 pounds.

Study of Activated Sludge

A paper in the Journal of Industrial and Engineering Chemistry by John Arthur Wilson, William Copeland and Henry Mills Heisig, is abstracted as follows in "Public Health Engineering Abstracts":

Results are given of tests on activated sludge between October, 1920, and August, 1921, with hydrogen-ion concentration, temperature, septic action, and re-aeration. The optimum hydrogen-ion concentration for rapid filtration of sludge seems to be at about 3.2. The optimum temperature had not been definitely determined, but tests carried out at 22° C. showed better results than identical tests carried at 11° C., and 34° C. indicated that the optimum temperature lies between these latter two. Fresh sludge was filterable at considerably higher rates than septic sludge, regardless of hydrogen-ion concentration or temperature. Re-aeration of septic sludge materially improved its filterability. The temperature at which the best results seem to be obtainable would indicate that the action is due to bacteria than to enzymes. The addition of one-tenth per cent of aluminum sulfate reduced the time record for filtering sludge, and it was found that the optimum of hydrogen-ion concentration with aluminum sulfate was higher than without. The cost of treatment with aluminum sulfate, however, was found to be greater than that of aeration, with results not as good.

A Year's Operation of Direct Oxidation

Results obtained at the Allentown plant, as described by the city engineer. Cost of operation at full capacity of plant estimated from actual cost. No nuisance created, operation reliable, effluent stable.

The sewage treatment plant at Allentown, Pa., which uses the Landreth Electrolytic process called "Direct Oxidation" was described in the issue of "PUBLIC WORKS" for Oct. 8, 1921. The city engineer, Harry F. Bascom, read a paper before the American Society for Municipal Improvements in October, the title of which was "A General Review of One Year of Successful Operation of the Direct Oxidation Process of Sewage Disposal at Allentown, Pa." He first described the plant. This description it is not necessary for us to repeat, but the remaining part of his paper describing the results obtained was as follows:

During the past year the plant treated 73,000,000 gallons of sewage without the slightest evidence of nuisance or complaint and produced an effluent which was consistently and uniformly stable and of low bacterial count. The sewage is a normal sanitary sewage and its composition as well as the average composition of the effluent is shown in the following table:

Results of Sewage Treatment

	Raw Sewage P.P.M.	Effluent (1 hr. set) P.P.M.	Percent. Change
Suspended Solids			
Total	150	69	—54
Volatile	110	46	—58
Oxygen Consumed	17	8.1	—53
Free Ammonia	21	13	—33
Nitrogen			
Dissolved	10.4	7.7	—26
Total	24.0	14.6	—39.1
Chlorine	117.0	123.0	+ 5
Alkalinity (as $CaCO_3$)	287.0	50 *	
Bacteria			
Total 37°C	2,036,000	12,000	—99.6
B. Coli.	87,000	18	—99.98

* Causticity as CaO.

The sludge as removed from the sedimentation basin contains 94% moisture and amounts to 21 cubic yards per million gallons. After 4 to 6 days drying on the sludge beds in normal weather the volume shrinks to 11 cubic yards and the moisture content drops to 71%. Therefore, when dry the sludge will amount to about 3 cubic yards per million gallons.

It is interesting to note that the wet sludge as taken from the sedimentation basin was absolutely free of colon bacilli, contained 44,000 total bacteria and when diluted with river water and distilled water had a stability of over 99% with methylene blue in dilutions ranging from 1 to 25 up to 1 to 1,000.

During the year the sludge has in the main been satisfactorily used for filling around the plant, although in some instances truckers have carted it away and used it on their farms, and they report that it is a very good growth stimulant, soil corrector and improves the mechanical property of the soil.

Regarding the cost of operation, this will vary in different localities due to labor, the cost of power and to the hardness of the water supply. Allentown is unfortunate in this respect in that its water supply is well above the average in hardness and therefore requires much more lime than many other communities. However, during the past year accurate records of cost have been obtained and as the flow is continually increasing, these data have been computed and checked, and when the plant operates at full capacity or 3,000,000 gallons per day our figures show that the cost will be as shown in the accompanying table.

During the year several improvements have been made in the lime dosage, a new slaking

Cost of Operation per Million Gallons at Full Capacity of Plant (3 million gallons)

Power, 213 KWHr. @ 2.8c	$5.96
Lime, 0.6 ton @ $9.10 per ton (86% CaO)	5.46
Operators, $135; 2 @ $125; 1 @ at $100 per mo.	
Labor—Laborers, 2 men @ 40c per hour	7.61
Heat	.08
Light	.17
Misc. supplies and repairs	1.02
	$20.30

Giving an operating cost of $20.30 per million gallons.

chamber was installed and the lime added further upstream from the electrolyzers, giving better slaking and mixing; also effecting a saving of approximately 25% in the quantity of lime used.

Lately a new type electrolyzer was installed and tested out showing a reduction of 50% in the hydraulic head required as well as an electrical efficiency considerably greater than the older type. This unit has the same effective electrode area as the older ones, but contains only a single row of 10 banks of electrodes and the agitators reciprocate instead of rotate, being driven from the top instead of the side.

Comment has been frequently made that the Direct Oxidation process is no more efficient than lime alone. In this connection a great number of tests have been made at Allentown both by the city chemist and by other investigators and the results are conclusively in favor of the Direct Oxidation process which gives an effluent that shows a greater reduction in oxygen demand, oxygen consumed, organic nitrogen and bacteria.

These tests also showed that the effluent produced by lime treatment, even though practically sterile when discharged, will putrefy if mixed with river water, while that from the Direct Oxidation process will stand up indefinitely. When we consider the experience of the British Royal Commission where litigation arising from nuisance has invariably followed from the installation of lime precipitating plants, and also the findings of the Massachusetts State Board of Health, these comments are untenable for we have yet to encounter any nuisance at Allentown.

CONCLUSION

A very significant feature about the operation of the Direct Oxidation process is that it is mechanical in nature and depends for its success, not upon the delicate adjustment of conditions in an endeavor so far as possible to favor the caprices of bacterial life, but solely upon simple mechanical contrivances whereby lime is fed into the sewage in sufficient quantities to render that sewage always slightly but definitely caustic, and thereafter to maintain an uninterrupted charge of electric current in the electrolyzers. Outside of these features the process is automatic.

Except in the screen room, where the raw sewage passes over the screens, there is no odor of sewage, stability being obtained in the electrolyzing units without production of odor.

No odors are present outside the building, even from the sludge beds. Fly and mosquito nuisances such as are always prevalent at all other kinds of sewage disposal works are unknown at the Allentown plant. A system of this type can be located at any part of the city where favorable delivery of the sewage can be accomplished, and especially where little space is available. Long, expensive trunk lines and isolation of the plant are therefore unnecessary, a great saving in dollars to the municipality.

The plant operates irrespective of weather or temperature conditions, purification being accomplished without the aid of living organisms, and its operation is free from all uncertainties of bacterial activity, is not affected by climatic conditions or by changes in sewage, and is positive in action.

The variation in flow of sewage through the electrolyzers up to the capacity of the unit has no effect upon the current required; in other words, any quantity of sewage up to the capacity of the unit requires the same amount of current as the rated flow.

This paper was followed by considerable discussion, chiefly by Messrs. Fuller, Johnson and Eddy, the general tenor of which discussion is indicated in the description of the proceedings of the convention in this issue of "PUBLIC WORKS."

Sewer Maintenance

Experience with cleaning seven miles of 15 and 20-inch sewer. Roots, stones and sand caused serious obstruction.

By D. C. Newman Collins, M. Am. Soc. C. E.*

The question often presents itself as to whether engineers or municipalities devote as much attention to the overhauling of sewers as they do to their enlargement or construction and whether their value as a silent and unseen guardian of our health and comfort is fully appreciated. The construction of sewers has been recognized as an important specialty in engineering, much like road building, and yet the road engineer does not stop at the completion of a road but uses his best effort to study and support its efficiency under abuse and hardship. Good road service is a product of good construction and of constant supervision and maintenance, the importance of each having a direct bearing on its satisfactory and economic performance.

The construction of a sewer seems to be considered as a final achievement and its maintenance rarely goes beyond a partial removal of obstructions which force themselves upon our notice, and even this is generally accepted as being an unavoidable offense that is expected to repeat itself while in reality the repetition is invited by indifference or inattention to its natural ills and lack of care of its special weakness.

* Township Engineer, Cranford, N. J.

SEWER CLEANING GANG AND HAND WINCH.

I venture to say that the maintenance of sewers is fully as important as that of roadways and their constructive economy will depend just as much on skillful upkeep as road construction will and perhaps to a much greater extent for there is no public property which suffers greater abuse than sewers and while they form one of the most expensive items in municipal development their failure is accepted as hard luck and they are apt to be condemned long before they reach their technical limit of capacity and very often for no fault of their own.

The writer has just completed a thorough job of cleaning the Cranford trunk sewer amounting to nearly seven miles of 15 and 20-inch vitrified pipe. The results are well worth while and the experience is interesting not only in the value of intimate acquaintance with its particular symptoms of disorder but also for its statistical value in regard to the behavior of old sewer lines.

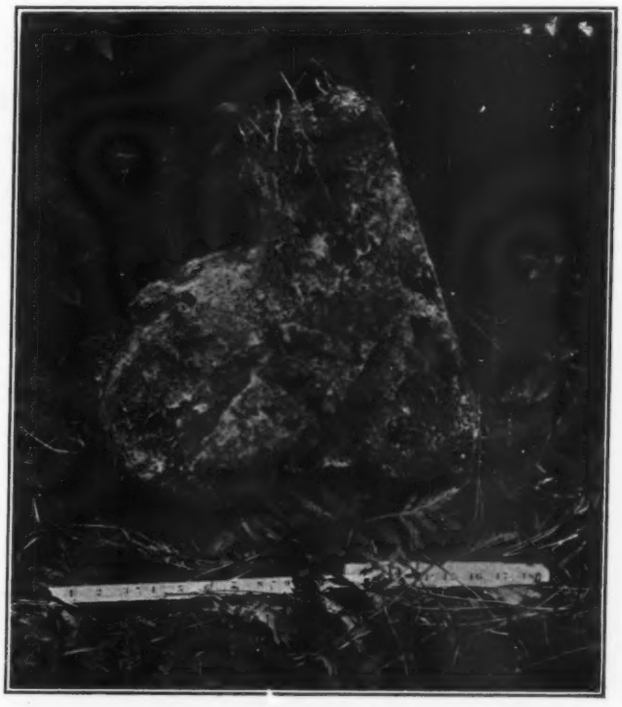
It will not be possible within the limits of this article to go into detail very far, but in a general way to describe the benefits and to dwell upon the location of obstructions, some of which may be avoided in the construction of new sewers.

The Cranford trunk sewer was built in 1894 and during its 28 years of life has fulfilled its mission as well as most other sewers have. During the past ten years it has been considered as having reached its capacity with the accepted excuse that the increase in population together with leakage, etc., is a natural cause. For several years an intolerable condition of backing up sewage into houses and spouting manholes after rains has been growing to a point where a heavy rain causes a continuation of these conditions over a period of many days before the sewers empty to a normal flow. I might add that the sewers of Cranford were designed as sanitary sewers and were not expected to dispose of storm water.

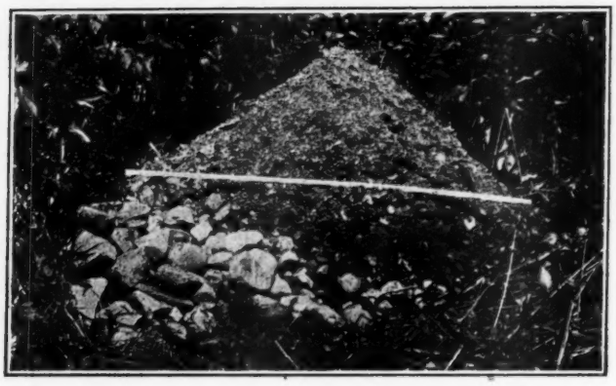
The citizens have patiently awaited the development of a large joint trunk sewer to serve all municipalities in the Rahway Valley which is a very natural and necessary enterprise and should be pushed to an early completion. I would emphasize that the results of the work herein described cannot be considered as a substitute for the proposed trunk line nor that it in any way lessens the demand for it, but that it will protect the new trunk from an unfair burden of heavy obstructions and gives Cranford once more the full capacity of the old trunk until the new joint trunk is in service.

From general indications of stagnation of flow and lack of action in manholes, the writer concluded there must be something wrong. After working in several local spots with a special home-made outfit with good results, but no general improvement, he decided the only way to locate trouble definitely would be to clean every foot of the trunk from its outlet. This was done with two full sets of equipment and two crews of men working under one foreman. The work was done with hand winches and heavy steel buckets with steel cable, using a float and line where possible and sewer rods when necessary.

A few of the largest obstructions are shown in the photographs to illustrate the handicap under which the sewer has been working and from the character and size of them it is reasonable to suspect that some of them may have been obstructing the sewer for a long time if not since its original construction. Large boulders were removed, not from a manhole but from the center of the pipe between. It seems hardly likely that they could have been moved along by the sewage flow to the position in which they were found. The bunch of roots weighing nearly 60 pounds when first removed (and considerable of its bulk was lost in the operation) was so closely compacted as to indicate its being there for a long time. It was removed from a section about 30 feet below the street surface where only one hard maple tree existed nearby. This obstruction alone may have caused most of the sewer trouble.



ROOTS FROM 20-INCH PIPE 30 FEET BELOW STREET SURFACE.



STONES AND DIRT FROM FOREST AVENUE SEWER.

In numerous spots great quantities of gravel, cinders, broken stone and a small percentage of miscellaneous matter was removed, in several places amounting to two cubic yards from one length of sewer between manholes. It is interesting to note that many of the finer grades of material forming obstructions had collected below a manhole where the sewer changed direction and where the velocity of the flow was impeded by a right angle bend in the sewer.

Immediately upon starting the work a great improvement was reported in the vicinity although the trunk line had not been touched. This local work was done to break in the men before starting them on the outlet several miles from home. The work was carried on faithfully through every foot of sewer and records were made of the location of any unusual condition for future guidance. In a general way the straight runs of pipe were fairly clean although many obstructions such as gravel, stones, barrel staves, iron rods and other unexpected items were removed. In the main trunk very little fats and offensive material was found but in the smaller laterals in town a greater quantity of grease, roots, soap and lighter material was encountered and especially in front of an invert under brooks or river the lighter matter would float and solidify, leaving the liquids to run off below until it formed a solid plastic mass which gave serious trouble.

Masses of roots were cut out, leaking manholes existed, cracked manholes were repaired. In certain sections considerable quantities of clean sand were found, perhaps due to careless connections of house sewers and probably also due to the practice of draining cellars and sewer trenches into the sewer during construction. In some parts of the town where quicksand existed the collection of sand in the sewer was always found.

The cost of doing the work is trifling compared with the benefit to every citizen in the Township. The work itself yields a gratifying interest to an engineer as an accomplishment of great value for small expense. To the workmen it offers a speculative charm as to the uncertain productions of the unknown under-world, and an occasional stick-pin, ring, collar button, bracelet, towel or set of false teeth was usually received in a spirit of victory like a prize package or a big bag of fish; and while they may not all be exactly appropriate for personal use or adornment the element of humorous curiosity is aroused to an extent that removed any smell of monotony in the work.

To a student in sewer construction the intimate acquaintance with sewer action, its vulnerable spots, constructive faults, inaccessible details and the practical merit or demerit of any particular sewer design will assure a first hand knowledge sure to broaden any technical mind.

Unusual Sewer Construction at Fort Madison

Reconstruction made necessary by raising of water level in the Mississippi river, due to the Keokuk dam.

By L. B. Reynolds*

The city of Fort Madison has a population of twelve thousand and is situated in the southeast corner of Iowa, on the Mississippi river, twenty-four miles north of Keokuk. The city is built on flat and gently sloping ground between the river and the bluffs. It is nearly four miles in length and varies from one-third of a mile in width at the east end to a mile at the west end. The old portion of the city with the business district, penitentiary, and several industrial plants, is at the east end, and the newer residence section, with Santa Fe shops and tire factory, is at the west end.

Prior to the completion of the Keokuk dam, in 1913, the stage of the Mississippi river varied from 0 up to 16 feet, a stage of 12 feet being normal each spring, with an extreme stage of 16 feet once in twenty years. For two years after Lake Cooper, formed by the Keokuk dam, was filled, the stage at Fort Madison averaged 12 feet, but during later years the water level has been held at 14 to 16 feet.

Up to the time when the Keokuk dam was completed, only the old extreme eastern portion of the city was served by sewers. Storm sewers ranging in size from 18 to 36 inches were laid on all north and south streets and to these mains about thirty blocks of so-called "sanitary" sewers, ranging in size from eight to twelve inches, had been connected. These branch lines had been laid in a most haphazard manner, oftentimes sloping in both directions from the center

* Member of the firm of Burns & McDonnell Engineering Co., Kansas City, Mo.

of the block. An even more serious condition was the connection into these small sewers of lamphole inlets from alleys mostly unpaved. Shortly after the dam was built another small district in the central portion of the city was constructed with similar storm inlets into eight and ten-inch laterals, some of which, furthermore, were laid on flat grades. Records of size, grade, and depth were almost entirely lacking.

When the Keokuk dam was nearing completion, the Mississippi River Power Company reconstructed all the sewer outlets and raised them to elevation 12. These outlets were submerged after the lake was filled to the higher level and have given increasing trouble since, due to formation of deposits in the pipe below water. The city recognized that not only had the existing system been damaged by raising the water level, but that facilities for the future sewering of the city had been impaired, thereby imposing further construction difficulties and adding to the cost

In the summer of 1916 the city retained the firm of which the writer is a member to make a complete survey of the city and design a comprehensive and adequate sewer system and report to the city the additional cost of such a system due to the raised water level in the river.

A trunk sewer along the river's edge to collect the sewage from all the existing sewers was not favored due to its large size and expense along with the necessity of pumping all the sewage. An intercepting sewer to collect all the dry-weather flow was not favored due to the expense resulting from the necessity of pumping the entire flow and providing capacity for an actual flow during storm periods much in excess of the dry-weather flow. It was decided to separate the storm and domestic sewage into two systems, utilizing the existing mains as storm sewers, and the existing laterals wherever well-built and suitable in size and depth, as sanitary sewers, but without any inlets for storm water.

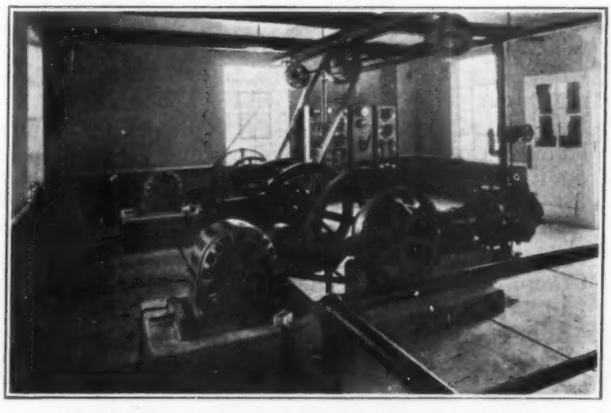
Surveys and plans for the new system were made by the writer during the summer of 1916. Due to the war conditions, construction of the sewer system was postponed until a new council was elected in the spring of 1919, on a sewer construction platform. Final surveys and plans were prepared and contract was let in June, 1920, to the National Constructon Company, of Davenport, Ia. Construction started in September, 1920, and the system was finally accepted by the city in August, 1922. The city eliminated the laterals in the extreme east portion of the city but retained the mains for serving this district. The system as constructed consists of eighteen miles of eight-inch to twenty-four-inch pipe and cost approximately $400,000. The Mississippi River Power Company, as a result of the report on damages, paid the city $50,000 toward the cost of the system.

The system is designed to provide basement drainage for the entire city. The sewage is all emptied untreated into the Mississippi river and the State Board of Health in approving the plans emphasized their belief that the United States Public Health Service, which would have jurisdiction over interstate streams, might and probably would at some future date, require treatment of the sewage before its discharge. This requirement governed the design to a considerable extent.

The new system has three gravity outlets serving the higher portions of the city and with outlet invert elevations above high water; also one pumping outlet serving the territory close to the river which is not high enough to be drained by gravity. The system is so designed that by the construction of two connections about twenty feet long and one twenty-two hundred feet long, the gravity outlets can be abandoned and all sewage turned into the pumping outlet; the pumping outlet is designed below these points for the ultimate flow after such connections are made.

Many difficulties were encountered during construction. All sewer pipe laid deeper than twelve feet was double strength; all three gravity outlets crossed railroad yards barely under the ties, where Class "D" cast iron pipe was used for considerable distances. Ordinary soil, dry flowing sand, quicksand and water-bearing gravel were encountered. The greatest difficulty was encountered on the pumping outlet which started at a depth of eight feet below river level at the pumping station and was laid through a gravel and sand formation with occasional stretches of quicksand. The contractor was protected in this work by a clause allowing him the cost of pumping and extra cost of sheeting and bracing necessary, and this extra amounted to over $35,000.

The sewage pumping station is located close to the river and the pumping equipment consists of three 150-gallon per minute pneumatic ejectors. The ejector pit is located in one end of the building with the motor-driven air compressors and emergency gasoline engine under the same roof. The construction of the pit was difficult, due to its depth below water level in the river, the bottom being about fifteen feet below in a gravel formation. The walls and floor of the pit were heavily reinforced and the walls were fifteen to twenty inches thick. The construction work was so well done that a match can be lit anywhere on the wall of the pit, due to the dryness of the walls.



INTERIOR OF SEWAGE EJECTOR STATION.

A. S. M. I. Convention*

Discussions of papers on sewerage and sewage treatment, street lighting, traffic and transportation, and refuse collection and disposal.

Thursday morning's session opened with the reading of a paper by Harrison P. Eddy entitled "Use and Abuse of Separate Systems of Sewers and Drains: Can Their Failure Be Prevented?" A written discussion of this was presented by Mr. Folwell, containing data on the subject which had been obtained some time previous through a questionnaire. (An abstract of this paper and discussion will be published in PUBLIC WORKS.)

The General Committee on Sewerage and Sanitation, Langdon Pearse chairman, presented a report containing data on a number of treatment plants, and a plea that urgent request be made to the Federal Government and others for a test by agricultural experts on the value of sludge as a fertilizer for growing root, stem, leaf, and fruit products, the experiment to include comparative tests of sludges from different processes used on various soils and under different climatic conditions.

T. Chalkly Hatton, chairman of the Sub-committee on Sewage Disposal, presented a paper entitled "Some Phases of Dewatering Activated Sludge at Milwaukee." He stated that that city had nearly reached the end of its investigation into the details of construction and operation of the activated sludge process. He reviewed the experiments that had been made in treating sludge by pressing, centrifuges, filters, separators and driers. Of all the appliances tried to date, the best results had been obtained by vacuum filters, experiments and tests with which were still going on. Presses and centrifuges, considerable hope of which had been entertained, had proved insufficient in the test conducted through 1921 and the early part of 1922. Tests are now being conducted with the Oliver vacuum filter. This works with a vacuum varying from eleven inches to twenty-two inches and produces a sludge with a moisture content varying from 72% to 78%. The sludge is raised to 160 degrees Fahrenheit by exhaust steam before being passed to the vacuum filter. Some of the processes which had previously been thought promising, while satisfactory under summer conditions did not prove to be so under winter conditions. Mr. Hatton referred to the experiment of the Maclachlan process which had recently been conducted in Houston with such promising results.

"Experiments in Centrifuging Sewage Sludge" was the title of a paper by H. B. Cleveland, chief engineer of the Barth Engineering & Sanitation Company. In this he described experiments that had been and are still being conducted at the Milwaukee and Baltimore sewage treatment plants. The company believes that it will shortly be able to offer an excellent appliance for treating sludge, though it has not yet reached a satisfactory development of the apparatus.

One of the most recent changes it has adopted is the introduction of a "drainage ring" in the apparatus at the Baltimore plant and this gives promises of being quite successful.

Statistical data concerning "The Value of Activated Sludge as a Fertilizer" was then presented by I. P. Kane, assistant engineer of the Sanitation District of Chicago.

In discussing these papers and reports T. C. Schaetzle, sewage treatment chemist of Baltimore, stated that at that plant the odors (which have caused considerable comment by visitors) were almost entirely from the raw sludge and that there was practically none from the digesting tanks when these were properly filled, and none from sludge dried upon sand beds. Part of the sludge is taken by a company that has a plant located on the sewage disposal grounds (see Public Works for March 25, 1922), and farmers take the balance of it, for which no charge is made. M. D. Tark, engineer of the Link Belt Company, said that it had been found that different sludges were adaptable to different soil and climatic conditions. C. M. Osborne believed that there was little hope of finding a sale for grease derived from sewage, as approximately 8% of such grease was unsaponifiable and no market could be found for such grease whether from sewage or garbage. He also expressed the opinion that all sludge sold for fertilizing purposes must be disposed of for local use, since the weight and bulk of the material and its comparatively low value made it impracticable to pay freight upon it.

The discussion of papers was interrupted at this point to permit the election of officers and selection of place of meeting and other business. The actions taken have already been reported elsewhere in this narration of the convention.

Following the business session, George W. Fuller gave a brief report and a paper (which had been published in the advance papers) entitled "Recent Developments in Sewage Treatment." This paper (an extensive abstract of which will be published in PUBLIC WORKS) gives the latest facts concerning skimming tanks, fine screening, separate sludge digesting tanks, Imhoff tanks, single-story tanks used in rotation, plain sedimentation with continuous sludge removal, contact beds, trickling filters, activated sludge process, sludge handling, final tanks, and finally the electrolytic or direct oxidation process. Discussion of the paper was confined chiefly to the last-named subject, following the reading by H. F. Bascom, city engineer of Allentown, of a description of a direct oxidation plant in that city, and the result of a year's operation of it. Mr. Fuller had described the process at some length and gave the claims of the proponents and opponents of the process. Col. George A. Johnson, who was not present, had sent a written discussion in which he expressed the highest opinion of this process as being always re-

*Continued from page 187.

liable because it is the only one that does not rely on bacterial action. Mr. Hatton stated that the sewage treated at Allentown was very weak and that therefore reliable general conclusions could not be drawn from this plant, but Mr. Moerk, engineer of the company controlling the direct oxidation patent, stated that the sewage was not weak but was as strong as that being treated at Worcester. Mr. Hatton also thought that the fact that the Allentown plant, though having a capacity of three million gallons, was treating only four hundred thousand to seven hundred thousand gallons per day, was an important factor in minimizing the value of the test. Also it seemed to him that adequate consideration had not been given to the disposal of the large amount of sludge that is being created. Harrison P. Eddy expressed the opinion that the cost of operating a direct oxidation plant was an important objection to its introduction. It is comparatively easy to bring taxpayers to the point of raising funds for constructing a sewage treatment plant but it is difficult to obtain funds later on for keeping it in proper operation. Consequently the most successful results are likely to be obtained by adoption of that plan which gives a minimum operating cost even though the construction cost might be higher. Moreover, while the direct oxidation process might produce a higher degree of purification than other processes, he believed it impracticable to endeavor at this time to attain ideals but thought actual progress would be attained by accepting a reasonable approximation to ideals. That the direct oxidation process was a proprietary one he considered no argument against it, since patented processes and appliances were used in all other branches of engineering. Mr. Fuller called attention to the fact that conditions as to lime demands by this process vary widely and that it consequently would be much less expensive to operate in some places than in others. Referring to the matter of sedimentation tanks, Glen D. Holmes stated that in tests made in Syracuse it was found that little additional precipitation was secured by reducing the velocity to flow through a sedimentation tank to less than 2½ feet per second, but it appeared that the percentage of precipitation depended almost entirely on the length of the detention period.

Mr. Bascom then read by title his report as chairman of the Sub-committee on Public Comfort Stations, the report having been published in the advance papers. It consisted chiefly of tabulated data concerning public comfort stations in the United States and Canada, sixty-nine cities having reported such stations, and a second table giving details of comfort stations in fifty-three Pennsylvania municipalities. Mr. Bascom was surprised to learn the small amount of interest taken in this subject by a large number of state engineers, which brought out all the more favorably the advanced stand taken by Pennsylvania, one illustration of which is the state law which permits counties to assist financially in the construction of comfort stations at county seats.

On Thursday afternoon the members and guests were driven to points of engineering interest in the city, the ride terminating at Nela Park, the headquarters of the National Lamp Works of the General Electric Company. Here there was a daylight inspection of street-lighting equipment, including different forms of lantern units and of standards, the latter being of various makes. At six o'clock a buffet dinner was given in one of the buildings in Nela Park, following which the evening program was held in the same room.

In opening the evening session a short address of welcome to Nela Park was given by R. W. Shenton, assistant manager of the Engineering Department of the National Lamp Works, who also presided at this session. In the absence of the chairman, C. W. Koiner, the report of the Committee on Street Lighting was presented by Earl A. Anderson, illuminating engineer of the Engineering Department of the National Lamp Works. In this report a general discussion was given of the latest tendencies in street lighting. It was stated that the lowest candle power that should be used for street lamps was 100, and that incandescent lamps were commercially available up to 2,500 c.p. For small lamps about three-quarters of the annual cost is for fixed charges, and, consequently, the additional cost of the brighter lights is only a slight percentage of the total cost. Ornamental lamps, which were formerly the exception, are now becoming standard for all street lighting. Reference was made to the new units designed for lighting highways, which are being adopted in several places. While cost is not the best unit for measuring effectiveness of street lighting, it has its value as a convenient one, and the cost for resident streets with fair to good illumination is found to vary from 20c to 80c per lineal foot of street, while for business streets it ranges between one dollar and four dollars.

This was followed by a paper entitled, "Modern Requirements in Street Lighting," by T. W. Rolph, street lighting engineer of the Holophane Glass Company. Mr. Rolph discussed the various requirements, not only of the lanterns and their glassware, but also of height, spacing, location, etc. He reported that very extensive tests had indicated that the minimum height at which a street lamp should be placed in order to avoid the objectionable features of glare is fifteen feet above the roadway, while greater heights are desirable for long spacing and where the branches of trees will permit.

"Interesting Features of Street Lighting Systems in Cleveland Suburbs" were described by A. E. Suker, street lighting specialist of the General Electric Company.

The meeting then adjourned to the museum of the company, where a very complete collection of types of lamps or other lights of all ages and countries had been collected. The ladies and other visitors not interested in the technical discussions had meantime been entertained by motion pictures, showing the history of lighting and of lamps, and a radio concert, which had

been arranged by L. C. Kent and O. F. Haas, of Nela Park. Just before adjourning for the night the company lighted for the first time a new 30,000-watt 60,000 candle-power incandescent tungsten lamp, the largest incandescent lamp ever constructed. This lamp, located on a low tower on the grounds of Nela Park, gave sufficient light to enable a panoramic photograph of the guests to be taken as they were grouped about the lamp at a radius of about 75 feet. This lamp had been constructed for moving picture work.

FRIDAY'S SESSION

The session of Friday morning was the final one of the convention. It opened with the report of Prof. A. H. Blanchard, as Secretary of the Committee on Standard Tests for Non-Bituminous Paving Materials. This committee recommended the adoption of fifteen tests which had been before the society for a year. It was decided to adopt the report tentatively until the 1923 convention, criticisms to be submitted to the Committee before July 1st of next year.

Prof. Blanchard then read his report, as chairman of the Committee on Traffic and Transportation, in which he presented, as a basis for traffic ordinances, a very complete assemblage of regulations as to both vehicular and pedestrian street traffic. In discussing this, Charles A. Mullen questioned whether the proposed regulations sufficiently protected the pedestrian in his legal rights, expressing the fear that it would place upon him the burden of proof in case of all accidents, but Prof. Blanchard stated there is no intention to do so except where the pedestrian was guilty of negligence or carlessness. Prof. Blanchard urged that the society become a member of the International Association of Road Congresses, which, at the present rate of exchange, would cost only about nine dollars, and the society voted to do so.

The next report was that of the General Committee on Street Cleaning, Refuse Disposal and Snow Removal, A. P. Folwell, chairman. The committee presented a report on "Refuse Collection and Disposal," giving statistics from about 150 cities and promising to prepare for publication in the proceedings a complete tabulation covering both collection and disposal in approximately double that number of cities.

Abstracts from a paper by Samuel S. Greeley entitled, "Modern Methods of Disposal of Garbage and Some of the Troubles Experienced in Their Use" were then read by M. N. Baker, Mr. Greeley having been called away a short time previous. This paper was quite an exhaustive discussion of the subject, based upon the author's most intimate acquaintance with it for several years past.

H. M. Farnsworth, president of the Metropolitan Park Board of Cleveland, then described briefly "The Park Systems of Metropolitan Cleveland," a paper which had been postponed from Monday evening.

The closing reports of the convention were those from representatives of the society in other organizations. Several of these had no reports to make, but brief reports were given from the representatives on the National Safety Council, the American Engineering Standards Committee, the Paving Brick Committee of the U. S. Dept. of Commerce, and the American Construction Council. After adopting the resolutions of thanks presented by the Committee on Resolutions, the convention adjourned.

Typhoid Fever and Water Supply

Some interesting statistics concerning water supplies and the effect of improvements in such supplies upon typhoid fever rates is contained in a paper by Langdon Pearse and S. L. Tolman dealing with the water supply and sewage disposal of the larger cities around the Great Lakes, presented before the American Public Health Association.

One of the tables gives the typhoid rate for all cities over 100,000 population from 1900 to 1920, inclusive, with the exception of a few cities where all of the figures are not available. These show a typhoid fever death rate per hundred thousand in 1900, varying from a minimum of 13 in Camden, N. J., to a maximum of 144 in Pittsburgh; while in 1920 the minimum rate was 0.7 for Paterson and the maximum was 14.9 in Birmingham. Not a city but had reduced its typhoid rate considerably.

In a number of cases the water is not purified at the present time, apparently not even by sterilization, so that a considerable part of the improvement was probably due to general sanitation and better conditions of milk and other foods used. For instance, in the case of Boston, for the years 1900 to 1908, inclusive, the typhoid death rate was above 20 every year but one, while during the years 1916 to 1920 it was below 3.7. On the other hand, a large part of the improvement in the case of Paterson, which uses water from the Passaic river which is filtered and sterilized, is probably due to such treatment; during the years 1900 to 1903 the rate ranged from 22 to 34, while since that time the range has been between 9.7 and 0.7. The best showing made is that by Pittsburgh. During 1900 to 1907, inclusive, the rate in that city varied from 107 to 144, while from 1909 to 1920 the range has been between 29 and 5.6.

In commenting upon the failure of some cities to lower their typhoid death rates by treatment of the water supply, this report states that "the use of dual water supplies in many of the industrial plants of the Calumet region may still be a possible source of typhoid. In such dual systems the use of polluted water is common." (It may be remembered by some of the older sanitary engineers that when filtration of the water supply was begun in Lawrence, but unfiltered water was also used in the mills for industrial purposes, in spite of warnings hung over faucets yielding the latter, the employees continued to use the unfiltered water and not until such use was discontinued did the typhoid death rate show a maximum decline.)

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Typhoid and Water Purification

A careful inspection of the table presented by Mr. Pearse in his paper before the A. P. H. A. referred to elsewhere in this issue gives rise to questions and conjectures as to whether too much credit has been claimed for water purification as an agent in the reduction of typhoid death rates.

Of the sixty cities of 100,000 population listed in the table, seventeen are reported as using no method of purifying their water supplies. Twelve of these are surface water supplies and five are well supplies. The remaining 43 cities are reported as treating the water in some way, in most cases by filtration either with or without sterlization, but in seven instances with sterilization only.

One peculiar feature noted in grouping the figures in the above way is that in 1920 the rate for the cities giving the water no treatment was 3.24, while for the cities treating the water the average was 5.6, or 75% higher. For well water which is untreated, the average is still higher, being 8.0.

Another point which may have some significance is that during the twenty years the typhoid death rate in those cities now treating their water has been lowered 87.2%, while in those cities that do not now treat their water in any way the improvement has been 89.4%. In other words, although a considerable percentage of the cities that now treat their water have introduced this treatment during the past twenty years and thus reduced the death rate by 87%, the twelve cities that have not introduced any treatment of the water have made an even greater reduction. From this it might be argued that the reduction in the former case was not due at all to treatment of the water, but to other causes which operated in both classes of cities alike—possibly improvement in the milk and other food products as well as in general sanitation.

The fact that only five cities use untreated well water does not warrant drawing any general conclusions concerning such use, but there would seem to be some significance to the fact that none of these five had a death rate in 1920 below 6.7, which is higher than the majority of the cities using treated surface supplies and more than double the average of the cities using untreated surface supplies, and higher than any of these with one exception.

Undoubtedly too much weight should not be given to these figures without a serious consideration of the attendant conditions in each case. For instance, it will probably be found upon examination that in the twelve cases where there is no treatment the water is naturally so well protected from contamination that treatment is not vitally necessary; while in the majority of cities where the water is treated, this water is more or less highly polluted and without treatment would result in a death rate much higher than that which now obtains.

The fact remains, however, that the typhoid rate has been reduced more than 89% on the average in twelve cities without treating the

water supply, which would seem to be an almost positive proof that a considerable part of the improvement in typhoid conditions in American cities during the past twenty years has been due to causes other than the improvement of the water supplies.

The Government Sprinting Office

The United States is proud of the rapidity with which it equipped, trained and transported a million soldiers to Europe. It is too bad some of the energy that put that through can not continue to be available for use at home—in the Government Printing Office, for instance.

We have received a copy of a 200-page bulletin on Colorado Oil Shales, giving information obtained during the past two years' co-operative investigation of the U. S. Bureau of Mines and the State of Colorado, which is published by the State "that it might be available sooner than if printed by the Government Printing Office." Apparently about three months were consumed in publishing this report. As it takes from one to two years to get most reports of the Federal Departments through the Government Printing Office, this action by the State appears to have been worth while and very commendable.

But why can not the Federal Government do as well as a State Government?

Rochester Engineering Society's Publication

The Rochester Engineering Society has just published the first issue of a monthly which is intended to serve the Rochester engineers, architects and others whose intersts are closely allied to these, most of whom are now members of one or more of nine engineering societies in the city.

No name has yet been assigned to the magazine, which appears this month with a large question mark on the cover, but the Board of Governors is offering a five-dollar cash prize for a name which shall "have some originality and individuality and be one which will include within its scope all the kinds of members that should be included in the nine local societies which we aim to serve."

United States Engineering Positions Open

The U. S. Civil Service Commission announces open competitive examinations for junior engineer, junior physicist and junior technologist for the Bureau of Standards, for duty in Washington or elsewhere, at salaries from $1,200 to $1,500 a year. Examinations will be held on November 22nd.

The Commission also announces examination for computer in the Coast and Geodetic Survey for service in Washington, D. C., at $1,400 a year, and at Manila, P. I., at $2,000 a year. Examinations for this position will be held December 6th and 7th.

Tight Sewer Pipe Joints

Since publishing the editorial in our August number entitled, "TIGHT JOINTS IN SEWER PIPES," we have received a letter from E. H. Rogers, city engineer of Newton, Massachusetts, in which he states that for about five years past the city of Newton has used sand and sulphur as a sewer joint compound for pipe sewers and house connections exclusively, having laid 7½ miles of sanitary sewers and the same amount of house connections in that time. Mr. Rogers refers to the Journal of the Boston Society of Civil Engineers for February, 1918, in which is published a description by him of his use of this compound.

Prevention of Fire in Highway Bridges

Wooden Bridge Floors Liable to Fire. Recommendation of Committee as to Construction and Maintenance Calculated to Prevent Fire

During the hot, dry periods of summer, fires have been very frequent in the wooden floors of the steel bridges crossing the rivers in the city of Pittsburgh. During last summer on one bridge fires were a daily occurrence and not infrequently two or three fires occurred in one day. They have been of minor importance only because they were extinguished before the flames had obtained much headway.

In the city of Holyoke, according to the report of the Fire Commissioners for 1921, the department that year responded to 170 fires on the various bridges, 64 of these being in June alone. Following this month the number was greatly reduced by the sending of a sprinkler over the bridges frequently during the day. These fires were almost always the result of cigarette stubs.

The old Raritan river bridge at Perth Amboy, prior to 1922 was decked with closely laid planked flooring, and no fires are known by State Highway Engineer Wasser to have occurred, but this year the deck was replanked with heavier lumber laid with half-inch openings, and there have already been several small fires.

These illustrations, from three cities only, indicate the necessity for precautions in construction of wooden bridge floors to prevent their destruction by fire. A report on the subject has just been issued by a committee composed of George W. Booth, chief engineer of the National Board of Fire Underwriters; L. T. Ericson and C. M. Taylor, officials of two wood-preserving companies; D. F. Holtman and C. J. Hogue, officials of lumber manufacturers associations; F. E. Schmitt, of Engineering News-Record, and E. F. Kelley, of the U. S. Bureau of Public Roads; which report is based upon extensive correspond-

ence between the committee and city, county and state bridge engineers.

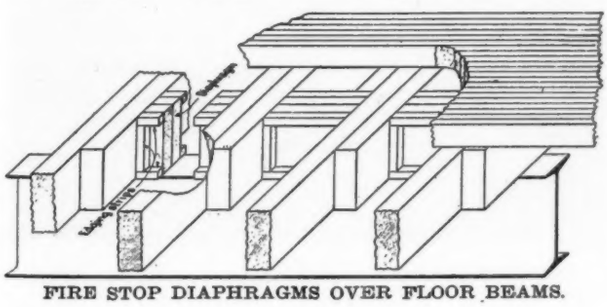
The committee finds fires most commonly caused by the lodgment of lighted cigars or cigarette stubs in cracks or depressions where chaff and debris have collected. Decayed or splintered material in the floor adds greatly to the fire risk. In the case of country bridges, the greatest risk is from forest and grass fires. Other causes are: Sparks from locomotives, hot coals from steam rollers or other construction equipment, burning waste from street-cars, defective insulation of electric wiring, and fire in adjacent structures.

Creosoted material appears to be somewhat more difficult to ignite than untreated, but once ignited it gives a fire that is hotter and more difficult to control. Freshly creosoted material is more inflammable than that several months old, and where such material is to be used for bridges it should be seasoned three to six months before use. In the case of freshly treated timber, the upper surface should be coated with sand.

In general, floors without open joints or cracks are most fire-resistent. The various types may be classified as follows in their order of resistance, beginning with those most resistent: Wood blocks on concrete base; wood blocks on planked sub-floor; laminated floor of 4 in to 8 in. strips laid on edge and spiked together, with a bituminous wearing surface; planked floor with bituminous wearing surface; laminated floor without wearing surface; multiple-thickness planked floor; single-thickness planked floor. In any case, steel joists supporting the floor reduce the risks of spread of fire. Where wooden joists are used, the fire risk will be reduced by using heavy timbers.

Special care should be exercised in designing the floor and its supporting structure to avoid ledges or pockets where trash may collect. In cases where such construction will not interfere with the proper disposal of floor drainage, curbs on timber floors should be constructed with ample clearance between curb and floor so that trash may have an opportunity to blow away.

Where stringers rest on floor beams, the spaces between them should be filled with tightly fitting diaphragms over each floor beam. These are preferable at least 6 inches thick and may be made of two thicknesses of plank spiked together. Battens should be placed around the edges of these diaphragms to cover cracks due to imperfect fitting or shrinkage. The accompanying sketch indicates the recommended construction.



FIRE STOP DIAPHRAGMS OVER FLOOR BEAMS.

In cases where limitation of head room is not a factor, fire curtains of sheet metal extending at at least five feet below the bottom of the joists and spaced at intervals of about fifty feet will materially assist in preventing the spread of fire. Corrugated asbestos covered metal used for siding and roofing of buildings is suggested for this purpose.

In the matter of maintenance, the committee recommends that floors, ledges, pockets and bridge seats be kept free from street sweepings and other trash; that underbrush, small timber and other inflammable material be kept removed for some distance on both sides of the bridge, grass and weeds being cut in the early fall and driftwood removed immediately after floods. Chemical weed killers may be used to prevent heavy growth of vegetation. Frequent inspection should be made of any electrical conductors on the bridge. The floors should be kept free from sprintered and decayed wood.

Provision for fighting fire should be made in the form of water barrels, sand boxes or water pipes. Water can be prevented from evaporating by a light film of oil and from freezing by dissolving calcium chloride in it. Where water pipes are used, they should have hose connections every fifty feet and hose reels every 200 feet. In cold climates they must either be protected against freezing or be kept empty with provision for filling them when needed with water under pressure.

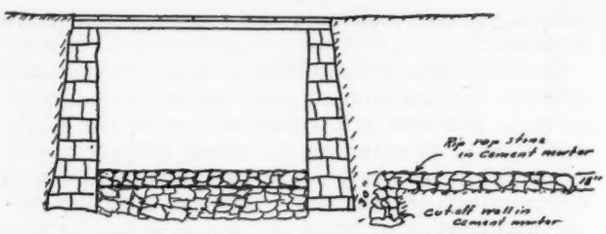
Maintenance of the under-structure and use of fire-fighting appliances will be facilitated by providing under the bridge floor, at points not more than 100 feet apart, platforms constructed of fire-resistive material, accessible by hatchways in the bridge deck or stairs on the outside. Where fire streams from hose and nozzles are available, there should be provided at 20-foot intervals, both longitudinally and horizontally, openings in the bridge deck to permit the use of cellar pipes, revolving nozzles or similar devices, these openings being not less than ten inches in diameter and provided with metal covers that can easily be removed but not readily displaced by accident.

Preventing Scour at Bridge Abutments

By O. H. Hampsch.*

The writer recently had occasion to repair a stone masonry bridge of approximately 16 feet span across a creek having a sandy loam bottom and which carried a very swift current that caused it to scour around both abutments. To prevent scouring, a floor was built across the bed of the stream 18 inches deep, of heavy rip-rap stone, hand-placed, with smaller stones wedged and tamped into place in the voids of the larger stone in the same manner as Telford base is built. Into this was poured a very wet mix of cement mortar, making it a monolitic mass. A cut-off wall 30 inches deep was

*Res. Engr., Tennessee State Highway Department.



SKETCH SHOWING STREAM BED PAVEMENT.

built on the upstream side across the face of this floor, as shown in the sketch, so as to prevent any current undermining this floor. In constructing this wall mortar was poured as wall was being built up.

A similiar cut-off wall on the down-stream side of the culvert would be desirable in many localities to prevent back-wash and undermining of the floor at this end.

This construction made a very satisfactory and economical repair, the cost being approximately $4.00 per cubic yard in place.

Cemeteries and Ground Water Supplies

In the latest report of the Department of Public Health of Massachusetts is an account of investigations made on the corrosion of pipes, the conclusion from which is that there is no reason to change the long-held opinion that "the active factor in corrosion is the acidity of the water, and this acidity is best ascertained by the determination of the carbonic acid present." Where the free carbonic acid exceeds seventeen parts per million corrosion may be caused, while if the amount is less there is little danger of trouble with brass, copper and iron pipes.

Analyses were made of large numbers of municipal water supplies and "in the course of this work it has been found that the presence of cemeteries upon the water sheds apparently had a direct effect upon the amount of carbonic acid present in the water supplies. For instance, in one of the cities of the state using ground water entirely and having a large area covered with driven wells, it was found that while carbonic acid was comparatively high in the water of all these wells, the higher amounts found were from the side of the driven well field on the edge of the water shed bordered by a continuous line of cemeteries laid out on sandy soil and extending for about half a mile in a line parallel with the well field."

Street Details in San Francisco

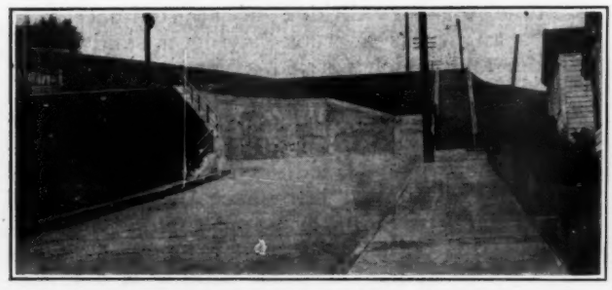
By C. W. Geiger

Special treatment for side-hill streets and streets too steep for vehicles; also for narrow roadways.

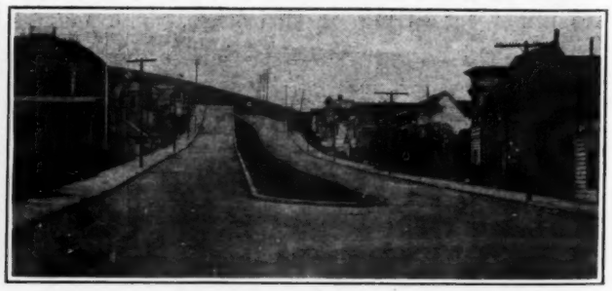
Some interesting methods of solving extreme grade conditions in the planning of streets in San Francisco are shown by the accompanying illustrations. Two of these show Quesada Avenue where one side of the street was considerable higher than the other at one end. At the beginning of this section the street is divided into two strips, an upper and a lower, each with its sidewalk and roadway. Each of these two strips is 22 feet wide and there is a 22-foot space between devoted to a sodded slope. At the far end the upper street is 14 feet higher than the lower. The lower street terminates in a dead end where there is a turning space, which is obtained by excavating into the slope of the hill and constructing a retaining wall surrounding this turning space. There are two stairways connecting the upper and lower levels. Asphalt pavement is used on the flat grades and concrete on the steeper ones.

Another illustration shows a section of Revere Street where it passes through a district of low-value property which did not seem able to stand the expense of constructing a roadway wider than 30 feet. In order to permit automobiles to turn around, there was constructed in the middle of the block a turn-out or widened section of roadway which has a maximum diameter of 42 feet. The normal width of roadways is 50 feet and therefore this construction cost only sixty per-cent. as much as the normal width plus the additional cost for the turn-out. As there is not much travel in this district, no inconvenience is felt because of the narrowness of the street.

A number of streets in San Francisco are so steep that they cannot be used by vehicles and in some of such cases the city turns over the street to the property owners in the immediate vicinity to construct terraces and the like. One of these terraces is shown in the illustrations, that at Lyon street. One view, taken from the top, shows the elaborate concrete work and in



QUESADA AVENUE. TURNING SPACE AT END OF LOWER LEVEL.



QUESADA AVENUE, WHERE UPPER AND LOWER LEVELS DIVERGE.

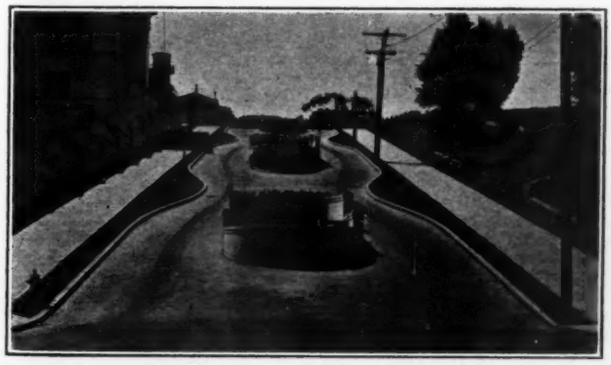
TURNOUT IN NARROW ROADWAY.
Thirty-foot roadway widened to forty-two feet in Revere Street.

the distance the Palace of Fine Arts and the California Building. Other instances of special treatment are shown in two other illustrations. One of these is practicable for automobiles and is used by demonstrators of automobiles to show the hill-climbing capacities of their cars.

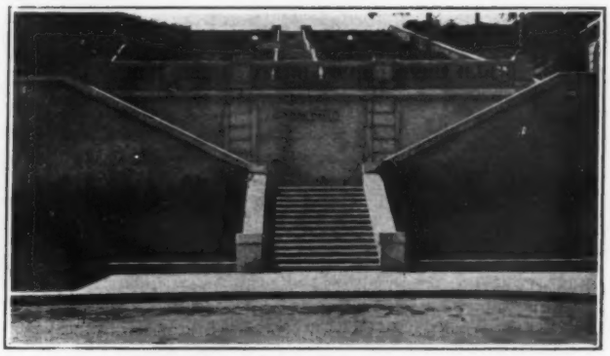
Another special construction on a hillside

STAIRWAY DOWN TERRACE.
Lyon Street, showing elaborate concrete work.

street shows a method of giving access from Jones street to Vallejo street, the latter of which is at a considerably higher level than the former at the intersection of the two.



TREATMENT OF ROADWAY ON STEEP HILLSIDE.
Used to demonstrate hill-climbing abilities of automobiles.



STAIRWAY UP TERRACE AT LYON STREET.

Rubber Pavements

The Department of Commerce, Washington, is authority for the statement that a rubber composition paving block has been produced by a London firm which, it is claimed, "can be placed on the market at a price to compete with the ordinary creosoted wooden block, when the advantages of absence from noise and long life,

SPECIAL CONSTRUCTION AT JUNCTION OF JONES AND VALLEJO STREETS.

estimated at 15 years, are taken into consideration."

Two types of blocks have been produced, one made with a core composed of a composition of rubber, jute and china clay, which is surfaced with a half-inch of hard vulcanized rubber, and another which consists of the core material only. In the first case the block can be vulcanized in one piece, which has been found to be necessary, since when a vulcanized block has been hollowed

MOUNTING BY WINDING ROADWAY AND STEPS.

out and filled with wood to reduce the cost it has been found that the rubber surface creeps and shows wear on the under side rather than on the surface. It is proposed to manufacture the blocks in sizes of 9x4½x3". Up to the present time it has not been found possible to manufacture these blocks at a cost less than three times that of wood paving blocks, or about $5.40 per square yard, and it is hoped that the price of paving will not be more than $13.35 per square yard.

Traffic on a Tennessee Road

An analysis of traffic on a Tennessee road has been made by Prof. N. W. Dougherty, of the University of Tennessee, in a brief article published in a Bulletin of the University of Tennessee. The traffic counts were taken by cooperation of the University of Tennessee, the Bureau of Public Roads, the Tennessee Highway Department and Davidson County. Counters were placed at thirty points, and forty separate counts were made.

On two of the main turnpikes a twenty-four-hour count was made, and the variation of traffic revealed by this count is shown in the accompanying figure. The total number of vehicles passing the stations in twenty-four hours was approximately 50% more than those passing the same station in the twelve hours between 6:00 A. M. and 6:00 P. M. The count was made in August, and toll roads in Williamson County showed that the traffic during August was approximately 50% higher than the average for the entire year. This appears to indicate that the average daily twelve-hour count in August is very nearly the average daily twenty-four-hour count for the entire year.

By a traffic census taken in 1916, it was found that there had been a small decrease in the number of horse-drawn vehicles, but the motor traffic had increased 420%.

A weighing station was established at one point, and by this was determined the rated capacity of each vehicle, the gross load in tons, the weight on the rear wheels, the tread of tire in inches, and load per one-inch width of tire.

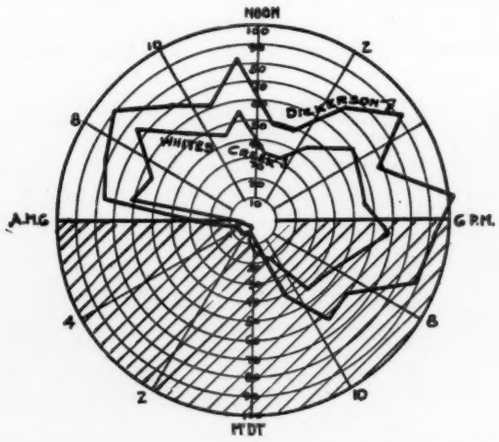


DIAGRAM SHOWING VARIATION OF TRAFFIC ON TWO TENNESSEE ROADS.

The rated capacity varied from one ton to 7½ tons, the vehicle with the former actually having a gross load of 2.79 tons and the latter 15.1 tons. Except the 7½-ton truck, most of the others had a gross load of 2½ to 3½ times the rated capacity. The load per inch width of tire varied from 645 lbs. for a 10-inch tire on a 3-ton brick truck, to 1,160 lbs. on a 2⅜-inch tire, this being a wagon carrying lumber.

Timing stations on a number of roads showed the average velocity of trucks to be 15 miles per hour, and of autos to be 24 miles per hour.

New Type of Highway Guards

A new type of guard for embankments and culverts on highways is being tried out in western Massachusetts by the State Highway Division. It consists of erecting a series of heavy posts, or concrete pyramids, five feet apart between centers along the edge of the embankment, although it is believed that seven-foot spacing would still prevent the passage of vehicles between them, and it is suggested that the distance could be still further increased to ten feet and the posts be joined by three-quarter-inch galvanized wire rope passed through eye bolts set in the tops.

The posts built in the test section are frustrums of pyramids twenty-four inches square at the base, twelve inches square at the top and equally battered on all four sides, and extending thirty inches out of the ground and twelve inches into the ground. It was thought best not to set them deeper and thus make them practically immovable, but yet to construct them so as to offer considerable resistance to overturning. The concrete is mixed 1:2:3:, in which are placed large stones, or plums, up to eight inches in size.

The forms are made so they can be easily removed and used repeatedly. The cost of this type of guard was about $3.50 per post, or 70c per lineal foot. Increase of spacing to seven feet would reduce the cost to 50c per lineal foot.

Where placed on concrete culverts, the posts are fastened to the culvert floor by dowels.

Maintaining Wood-Block Paving in Peoria

Peoria, Illinois, had had considerable trouble with the bulging of wood-block pavements laid about eleven years ago on its principal business street, which carries car tracks. For a number of years it has been necessary to make repairs after almost every heavy rain by cutting out the bulged sections and relaying the blocks. This year, Mr. Mortz, Commissioner of Public Works, has been doing more permanent work on this pavement.

Using a gang of about a dozen men he started at one end of the street to repair the pavement for the full length. First one side of the car track is put in condition and then the other side. Sections of pavement where there has been no heaving are not disturbed, but where the blocks have been displaced either by heaving or settling

they are removed and relaid. It is generally found that the sand cushion on which the blocks were laid has been displaced, apparently by water finding its way under the blocks, being piled into elevations in one point and washed into holes at others.

It is found on removing the blocks that only a little of the filler that was put in ten or eleven years ago remains adhering to the block, but that which does is removed. Where repairs are being made, the cushion is replaced with one of eight parts of coarse sand and one part of Tarvia B, which is mixed in an ordinary half-yard mixer and levelled off on the foundation for receiving the blocks. The blocks are then laid and the interstices filled with pitch, and coarse sand is thrown over the surface while the pitch is still hot.

Where the blocks are not taken up a coat of Tarvia B is spread over them and covered with sand. It is expected that this oil will add new life to the blocks and restore their imperviousness to moisture. Supt. Mortz believes that wood blocks should receive a coat of oil every two or three years to keep them impervious.

Pennsylvania Highway Bridges

As in most of the older states, the highways of Pennsylvania still contain at stream crossings a number of bridges of capacity both as to width and strength that is inadequate for present-day traffic. A survey recently made by the State Highway Department showed a total of 1834 bridges that are less than sixteen feet wide, many of them too narrow to permit two vehicles to pass. Plans are now being prepared to widen the more important ones as rapidly as the financial resources of the department will permit. The policy is to construct all new bridges with a width of at least 24 feet. In improving those which are not to be entirely rebuilt, the department will endeavor to retain the contour and general architectural characteristics of old structures which are landmarks in the communities where they are located.

Gasoline Tax for Motor Vehicles

Figures given for the first six months of 1922 by the Bureau of Public Roads of the U. S. Dept. of Agriculture show that seventeen of the States collected gasoline taxes as a method of providing funds for highway work. These States were Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Montana, New Mexico, North Carolina, Oregon, Pennsylvania, South Carolina and Washington. In Florida the tax was declared void in April. In all of these States the tax is one cent per gallon, we believe, except Oregon and South Carolina, where it is two cents. In Maryland a two-cent rate becomes effective January 1, 1923. In Arizona the total revenue from the gasoline tax was about 38% of that from registration fees, this being the maximum percentage; the minimum being about 8% in the case of Mississippi. The total gasoline tax for the six months for all the States is given as $5,510,846.

In the October 1 issue of the "News-Letter" of the Wyoming State Highway Department, the adoption of the gasoline tax for that State is advocated editorially. It is estimated that with a two-cent rate in Wyoming the gasoline tax would yield a revenue of between $270,000 and $300,000 for the year 1923. As it is estimated that $450,000 will be required annually for the next few years to properly maintain the highway system, this would result in the actual users of the road paying two-thirds of the cost in proportion to their use of it, while the remaining one-third would be paid by the taxpayers, which seemed to the department to be an equitable division.

The revenue from gasoline in States charging a one-cent tax averages about $4.50 per vehicle per annum. The total number of motor cars registered by July of this year throughout the country was 10,620,471. If a one-cent gasoline tax were applied in all States, therefore, the revenue so raised would apparently be between forty-five and fifty million dollars, plus the increase due to the continuous addition being made to the number of motor vehicles. Of this total registration for the country, slightly more than ten per cent. was motor trucks.

Black Base for a Chicago Boulevard

The West Chicago Park Commission is repaving Washington Boulevard from Halsted street to Ogden avenue, replacing an asphalt pavement which was laid in 1893. The roadway here is forty-eight feet wide. While nominally a boulevard, because of the fact that the streets intersecting the boulevard on opposite sides are not opposite each other but are staggered, heavy traffic using these intersecting streets must necessarily travel lengthwise of the boulevard in passing from streets on one side of it to those on the other. There are thirteen streets intersecting at intervals of about 330 feet, and the superintendent of the commission, William G. Barclay, reports that "The areas of the numerous intersections as well as those of parts of the roadway from which heavy or truck traffic cannot be barred . . . summed up, are probably 50% of the entire area, so that in effect the pavement will be subjected to a traffic similar to that on any business street nearby."

The old asphalt pavement had been laid upon a macadam base which had been greatly disturbed during the twenty-nine years since the pavement was laid, one corporation having made openings every twenty-five feet along the street and much repair and renewal work having been required on the underground structure during that period.

Supt. Barclay, in speaking of this improvement, said: "The Commissioners, knowing that additional materials were needed to provide a proper foundation, carefully considered the merits of portland cement concrete and black base. Their investigations of the bituminous type of foundation in several cities and the opinion of the engineers experienced in pavement construction convinced them that the

black base would be the better of the two. Being resilient, it absorbed some of the shock of impact of traffic, thus protecting both the wearing surface and the macadam base; the binder course could be eliminated, and the work would progress more rapidly, as no time would be lost as in waiting for a hydraulic concrete base to cure."

The boulevard is now being repaved with a standard two-inch sheet asphalt wearing surface upon a black base. Where the depth of base was more than 3½ inches it was laid in two courses. Standard Mexican asphalt is used in both base and wearing course, the amount of bitumen used in the former being 4.9% and in the latter 10.0%, the penetration of the asphalt cement being 41. The chief difference between the aggregates used in the base and in the wearing course respectively is that in the former the aggregates passing the 200, 80 and 40 mesh total about 17%, and about 80% in the wearing course; the base course containing about 28½% of ¾-inch stone, 24½% of ½-inch stone and about equal parts of 1-inch and ¼-inch material. The work is being done by the Commonwealth Improvement Company of Chicago, with William G. Foley as foreman in charge and Walter H. Flood & Company as chemical engineer. Supt. Barclay has general charge for the West Chicago Park Commission, and the Chicago Paving Laboratory makes the chemical inspection for the commission.

Concrete Sidewalks in Jacksonville

Jacksonville, Florida, years ago adopted regulations requiring that in certain sections of the city nothing but tile sidewalks should be laid. This is reported to have resulted from unfortunate experiences with concrete walks. It had not been practicable to have an inspector on each sidewalk and much poor work had been done, while the tile used for the walks could be tested by the city. City engineer Sheddan now favors constructing concrete sidewalks and prohibiting the laying of tile walks in front of business houses. It is reported that the ordinance will be so changed as to require a $500 bond for one year from every contractor building a sidewalk, conditional on his keeping the same in proper repair.

University of Michigan Highway Courses

The courses offered by the University of Michigan in Highway Engineering and Highway Transport have met with increasing approval by students of all classes and ages. In 1919-1920 the course was attended by 29 men, the next year by 45, and last year by 94. The average age of those in attendance last winter was 27, the youngest being 22 and the oldest 54. They came from national, state, county and municipal highway departments, from the offices of consulting engineers, contractors' organizations, university faculties, from companies manufacturing highway materials and machinery, and from the field of highway transport. Because of this growth in popularity, the Regents of the University have assigned for the purpose of these courses 26,000 feet of working space for the library, offices, lecture and drafting rooms, and laboratories in the new engineering building.

The course this year begins December 4 and continues until March 16; the week of February 12 to 16 being set aside for the Ninth Annual Michigan Conference on Highway Engineering.

Highway Magazines

Most of the State highway departments are now distributing bulletins of one kind or another throughout the state to keep the people informed of the work done by the department and secure the other advantages achieved by publicity. One of the latest of these is the "Montana Highway News," published by the Montana Highway Department, of which the seventh number has just been issued; this, however, being the first issue to be printed, the other six having been mimeographed and their circulation restricted to the employees of the department.

Says the "News": "The law requires and the interests of the taxpayers and road users demand that the people of the State be informed as to the status of state highway improvements and particularly as to the funds necessary and available therefor. In order, therefore, that this information may be provided economically and in convenient form, the Department will, for the time being, distribute monthly approximately 4,000 copies of the News."

Some of these highway bulletins are confined solely to figures and other information relative to work under way or contemplated, but the majority contain descriptions, generally illustrated, of construction work in different sections of the State, news items bearing more or less directly upon highway matters, and editorials calculated to present the doings of the Department in a favorable light and encourage the taxpayers to support good roads legislation. Many of them are well calculated to, and probably do, secure these things; but entirely aside from these advantages to the Department, the taxpayers are entitled to be given frequent and up-to-date information concerning the doings of a department which spends such a large part of the state and county taxes, and the publication of these bulletins would therefore seem to be amply justified.

Economical Subway Construction in Rochester

In constructing a subway for electric trains in the abandoned canal bed of the old Erie Canal in Rochester, N. Y., Scott Brothers, contractors, of Rome, N. Y., are securing economical results with the use of machinery. The bed of the canal, which is in rock, had to be enlarged, and the stone thus obtained was used for the concrete walls of the subway.

A Marion steam shovel loads the blasted rock into 5-ton trucks, twelve of which are used to carry it to the crusher, traveling in the canal bed. The crushed stone, sand and cement, in the proper proportions, are placed in Lakewood batch boxes, and

twelve of these are carried on a train of six small flat cars over industrial track by Plymouth dinkies to the mixer.

Here each box is dumped into the mixer as a batch. The mixed concrete is discharged into a tower bucket, and by this into a chute, which discharges it directly into the forms for the side walls of the subway, or onto the bottom or roof forms.

Illinois Changes Pavement Cross-Section

The following notice was sent, under date of October 23rd, to road contractors who were known to be interested in the construction of concrete roads for the Illinois Division of Highways.

To All Contractors.

The attention of all contractors who propose to bid on road work advertised for letting October 31st, or who propose to bid on work to be advertised at later dates, is called to the new cross-section for concrete pavements.

This cross-section provides for a thickness of nine inches, at the edges of the pavement, tapering to six inches at a distance of two feet from the edges. The remainder of the pavement is to have a uniform thickness of six inches. The amount and arrangement of reinforcement is to be the same as that heretofore used, with the exception of the center-joint material, a new design for which has been provided to correspond with the six-inch center thickness.

This new cross-section was adopted as a result of the Bates Road tests, which show conclusively that the strength of the edges of any rigid pavement, built in accordance with any design heretofore used, is much less than the strength of the interior portion of the slab.

The Bates tests disclosed the fact that a center thickness of six inches, or even perhaps five inches, is ample to support the legal load limit provided by Illinois statutes. The new cross-section takes advantage of this fact. The tests further indicate that even with a six-inch thickness for the main portion of the slab, a seven-inch edge with the three-quarter inch longitudinal bar would still not be as strong as the mid-portion of the slab. The edge thickness has, therefore, been increased.

Particular attention is called to the fact that the new cross-section provides one square foot less of cross-sectional area than a slab having a seven-inch uniform thickness. This means that the new cross-section will require 195½ cubic yards less of concrete per mile of pavement than the standard seven-inch design heretofore used.

The Department believes, therefore, that the new cross-section will provide a pavement which not only is better able to support trucks loaded to the legal limit, but will also reduce the cost per mile.

At first sight, it might seem that the cost of shaping the subgrade to accommodate the new cross-section would be troublesome. A little consideration, however, will indicate that the extra cost would be very small, as subgrading machines may easily be adapted to cut the subgrade to the new form. Even should the subgrade be cut to the usual crown, at an elevation six inches below the top of the forms and the dirt along the edges is then thrown out by hand, it may be seen that the additional cost of shaping the subgrade would be but a small item.

Contractors are earnestly requested to consider this new cross-section carefully, in order that we may cooperate as heretofore in building the best and the most durable roads with the least expense to the State of Illinois.

Very truly yours,
FRANK T. SHEETS,
Superintendent of Highways.
CLIFFORD OLDER,
Chief Highway Engineer.

Sand Filter at Chester, England

A novel feature of a slow-sand filter at Chester, England, is described briefly in a recent issue of the "Public Health Engineering Abstracts" of the U. S. Bureau of Public Health, being condensed from "The Surveyor" (England) for June 16.

The unusual feature of this filter is the fact that, while the top fifteen inches of sand in the bed is of such size that sixty per cent. is retained on a forty-mesh sieve, the twelve inches immediately below this is fine sand such that sixty-five per cent. is retained on a seventy-mesh sieve. Immediately under the fine sand is again fifteen inches of sand of the same size as that on top, under which is a layer of pebbles passing a quarter-inch mesh, resting on other pebbles passing a three-quarter-inch mesh.

"This form of filter has been in use for many years, and there is no doubt that the remarkable results obtained are due, in a great measure, to the action of this layer of fine sand. Sub-surface clogging takes place to a slight extent in the course of time, but this condition can be remedied by going down to the fine sand and removing a light scraping from its upper surface when replenishing the coarse sand removed by successive cleanings. There are practical reasons why the fine sand should not be placed on top, as the trampling it would receive in the course of cleanings would quickly reduce it to an impervious mass, and when removed to the sand washers, together with algae, mud and other debris, it would not be so readily dealt with as the coarse grade of sand." It is believed that by this fine sand the reduction of bacteria is made much more nearly complete. The rate of filtration varies from 0.75 to two gallons per square foot per hour.

Water Bills in Boston

In a recent issue of "PUBLIC WORKS" we called attention to a city which reported that all its water bills had been paid up to date. Apparently Boston is not nearly so fortunate or persistent in its collection, for Mayor Curley has announced that there are outstanding water bills in excess of $550,000, which have been accummulating since the year 1912, and he has requested the City Law Department to prepare a law for presentation to the Legislature making these water bills a lien on the property.

The shutting off of services, which was designed to compel payment of the bills and which has been carried on through the summer months, has brought in only $75,000, or about 12% of the total amount that was owing to the city in June.

The lien against the property that is contemplated by the proposed law will be similar to that applied in cases where taxes are owed the city on real estate. If demands for payment of the water bill remain unsatisfied, the city's lien on each property equal to the face of the unpaid bill will be sold to individuals, who will proceed to collect the bill in a manner in direct contrast to the leisurely way the city does that work.

Pipe Laying in New Bedford

Steam Shovel and Derrick Used in Trenching and Laying Large Cast-Iron Pipe, and Lead Substitute for Making the Joints, with Great Saving in Cost

In the September issue of "PUBLIC WORKS" a description was given of the present condition of the old steel 48-inch main of the New Bedford water works, and reference was made incidentally to the laying of a new 48-inch cast-iron main. In a paper before the Convention of the New England Water Works' Association, Stephen H. Taylor, superintendent of the New Bedford Water Works, described the water system of that city and, in connection with this, the laying of this new cast iron main, which he described as follows:

"In 1920 the department had about 6,600 ft. of 36-in. main to lay in addition to the ordinary extensions, and as labor was scarce, it was decided to purchase a 14B Bucyrus steam shovel with an extended dipper arm for trenching, and in 1921, when the 48-in. main was started, a 14B Bucyrus "Clamshell" and derrick machine with a 30-ft. boom was purchased. These machines have proved great money savers on the large pipe work which has been done in the past three years. The latter machine is used for pipe laying, and in places where the ground is too soft to support the steam shovel over the trench, excavating is done with the clamshell outfit on the same machine. Under ordinary conditions the excavation is done by the steam shovel travelling on platforms over the trench with the derrick following close behind, laying the pipe. The shovel deposits the excavated material into trucks which haul it directly to the backfill close behind, or to the spoil bank.

"With reasonably good conditions, from 120 to 180 ft. of trenching, pipe-laying and backfilling per day is accomplished with a crew of from 15 to 20 men, two or three trucks, and the steam shovel and derrick. The advantage of a small crew is particularly great in our present work, which is ten to twelve miles from the city, and as there is very little local labor available the men must either be boarded near, or transported to and from the job."

In laying this new main, leadite has been and is being used. The reason for adopting this material and the experiences and experiments leading to this determination are described in the paper as follows:

EXPERIMENTS WITH SUBSTITUTES FOR LEAD

"Until within a comparatively few years water works engineers have been pretty unanimously of the opinion that the best if not the only satisfactory material for jointing cast-iron bell and spigot pipe was a good grade of soft pig lead, well caulked.

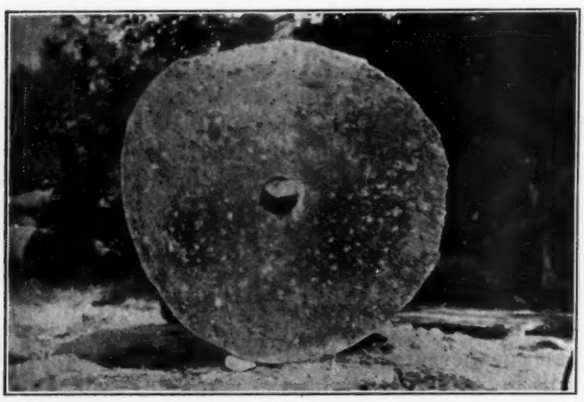
"During the past fifteen or twenty years various substitutes have been placed on the market and widely advertised throughout the water works field. The principal advantage claimed for these substitutes was the great saving of expense for both material and labor.

"The writer, like all good conservative water works officials, has hesitated to change from the established custom of using lead.

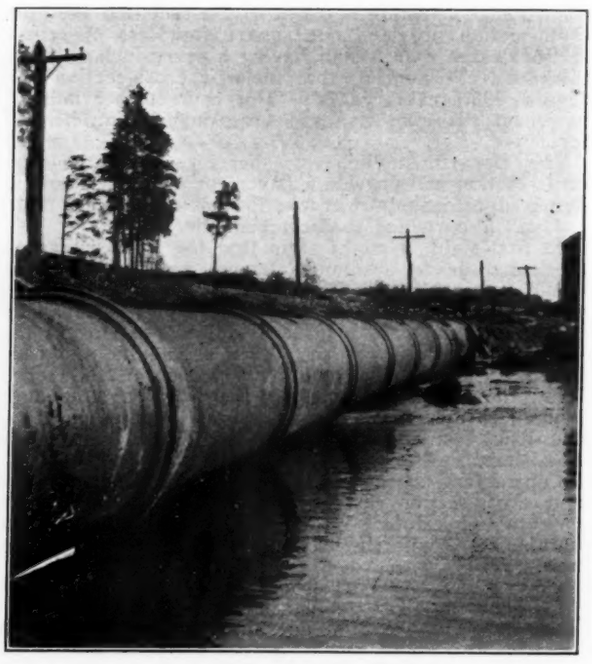
"Some ten years ago a few joints in the smaller sized pipe were made in the New Bedford water system with two of the substitutes,—Leadite and Lead-Hydro-Tite, and no trouble has ever been experienced from either.

"In the Spring of 1920, the writer decided to make some more extensive experiments with them. The city of New Bedford was then contemplating the laying of about 6,600 ft. of 36-in. pipe in addition to the usual yearly work, and as prices of everything were extremely high, any saving that could be made without decreasing the efficiency of the work was worth considering.

"At that time Leadite was offered at 12c. per pound and Lead-Hydro-Tite at 10c. while lead was selling for about 7½c. per pound. One pound of either substitute would fill as much joint space as four pounds of lead, so that it would take 30c. worth of lead to do the same work as 10c. worth of Hydro-Tite or 12c. worth of



PIECE CUT IN 1921 FROM 48-INCH STEEL MAIN IN SERVICE SINCE 1899.



SECTION OF 48-INCH CAST-IRON FORCE MAIN.

Leadite. There is also a further saving in the reduced labor cost, because no caulking is necessary, and the size of bell holes is greatly reduced. The only chance for skepticism, then, was as to their efficiency. As the contemplated work involved a considerable amount of jointing material, the two cents per pound difference in cost of Leadite and Hydro-Tite, was worth saving if the two materials were equally efficient. The experiments here described were made to determine this point as well as to determine their ability to stand high pressure, and the elasticity of the materials.

"The experiments were made with the assistance of Mr. W. R. Conard, engineer, Mr. Hays R. Kuhn, at that time employed by the Pennsylvania Water Co., who was familiar with handling Leadite, and Mr. Jacob Handy, superintendent of Dartmouth Water Works, who had considerable experience with Lead-Hydro-Tite. Mr. George McKay of the Leadite Company and several water works officials from nearby cities and towns were also present.

"*Experiment No.* 1. Six lengths of 6-in. pipe were put together on skids about two feet high in the pipe yard of the New Bedford Water Works, with a plug and sleeve on one end made up with lead and a patented plug in the other. Three joints were made of Leadite and three of Hydro-Tite. Dry white jute was used in its different forms, one joint with each material being made with loose yarn, one with the same yarn twisted lightly, and a third with the same yarn braided similar in appearance to packing, but without oil or grease.

"The pipes were first filled at city pressure (84 lb.) and the joints were all reasonably tight, the greatest leak occurring at the joint made of Leadite with loose yarn.

"There was also some leak at the joint made of Hydro-Tite with twisted yarn. The pressure was then raised, first to 150 lb. and then to 200 lb., all joints remaining reasonably tight and becoming entirely so with the exception of the two above mentioned. The high pressure was then released and normal yard pressure (84 lb.) maintained during the remainder of the test.

"The ends of the pipe were raised by means of a derrick at each end, the supports, which were under the pipe, being removed as the pipes were lifted from them until, for a short time, the line was practically suspended by the ends, forming a curve with about 144 ft. radius and the ends 5 ft. 9 in. higher than the center.

"Finally joint No. 5 of Hydro-Tite broke, allowing the center of the line to drop to the ground. It should be said, in fairness, that the joint which failed was not made with a continuous pouring, because some of the material was lost through a defective dam and a second pouring was necessary. Only a few seconds elapsed between the first and second pouring, however, as the kettle was close to the joint and it was only necessary to dip out more material.

"The whole line was then lowered to the ground and remained tight except the two joints before mentioned (No. 2 and No. 5). These were made tight by caulking with a little lead wool, and for several months the line remained in the yard in absolutely tight condition, in spite of the abuse to which it had been subjected.

"*Experiment No.* 2. As the principal work of the year was to be 36-in. pipe, it was thought advisable to experiment with this larger size to see if it could be successfully poured. Two lengths of 36-in. pipe were joined, with a plug in one bell and a sleeve and plug on the spigot end. Accidentally a class B pipe N. E. W. W. Assoc. specifications was placed into a class F bell. This made an unduly thick joint (about ⅞-in.). The class B bell was too small to receive the beaded end of the plug, so the plug was reversed. This made an abnormally thin joint with no bead, as the space was so small that it would have been impossible to caulk a lead joint. These joints were made with Leadite. On the other end the sleeve and plug were normal ½-in. joints and poured with lead Hydro-Tite.

"When the yard pressure was applied, in spite of the bracing at the ends, the joint between the two pipes slipped about ¾-in. This was the abnormally thick joint. The 84 lb. yard pressure on the 36-in. plugs developed a total stress on each of them of about 42½ tons.

LAYING 48-INCH CAST-IRON FORCE MAIN ON A CURVE WITH STRAIGHT PIPE.

"The braces were then removed and the pressure applied with the intention of pulling the work apart. When this was done the two abnormal joints made with Leadite held fast, and the one where the sleeve joined the pipe which was a normal ½-in. joint made with Hydro-Tite pulled apart.

"As a result of these tests, it was decided to adopt Leadite for our work, and it has been used in practically all the joints made since that time with excellent results.

"The story of this test would not be complete without further reference to the advantage of the braided jute packing, which we have also adopted for general use. We find that although it costs a little over twice as much per pound as the plain dry jute, the saving effected in labor and material more than offsets the extra cost, and that a better joint is obtained because there are no loose ends of the fiber to mix with the jointing material and reduce its efficiency.

"Since writing the above, a very favorable opportunity was presented for comparing the cost of 48-in. joints made of lead and Leadite, as two joints were made of lead on the check valves of our 48-in. line, because of the extreme weight of the casting and uncertainty of the ground in which it was placed.

"Figuring the cost of jute packing, labor and lead, a 48-in. joint cost $18.06; whereas the same items on Leadite joint cost an average of $4.42. It took three men one hour and forty minutes to pour and caulk a lead joint, whereas the same three men would average to pour from six to eight joints per hour with Leadite."

Water Supply for Parkersburg

Just about ten years ago the city of Parkersburg, West Virginia, put into service a water supply system by which the water was drawn from the Ohio river, being passed through a system of filters known as the "Smith System," the filters being laid in the bed of the river. This system was described in "MUNICIPAL JOURNAL" for February 15, 1917.

In a report to the city authorities, made about the 1st of October, E. A. Tisdale, sanitary engineer of the State Department of Health of West Virginia, stated that investigation showed that these filters have deteriorated to such an extent as to be no longer effective. "Muddy water, practically the same as the raw Ohio river water, has come through the filter beds into the city mains on numerous occasions during August and September, 1922. Also, bacteriological results of water tests, made by Dr. R. G. Lang, city chemist, shows the water has been unsafe for use at such times, despite the fact that a high dosage with chlorine gas has been maintained to disinfect the water. The time has come when Parkersburg must abandon the filter beds in the

river and turn to a more reliable system of obtaining a safe and satisfactory public water supply."

It seemed to Mr. Tisdale to be very probable that Parkersburg was wasting a great deal of water, the consumption being very high, and he recommended that a water-waste survey be conducted with a view to finding and stopping the leaks or waste. A supply of four million gallons would then be ample for some time to come.

He made no definite recommendation as to a new supply, except that careful investigation be made of the "gravel wall well filter system," proposed by the Lane & Bowler Company, which had offered to give a bond that they would produce the necessary quantity of water, and also that the cost of rapid sand filtration of the Ohio river water be investigated. The rapid sand filtration plant would cost about $120,000, he estimated, and the well system somewhat less. There was no question about the satisfactoriness of the former, and the only question about the latter appeared to be the certainty of a sufficient supply of underground water upon which to draw.

In 1908 Morris Knowles recommended obtaining a supply from wells, and in 1910 James H. Fuertes and George W. Fuller recommended filtering river water. The Smith filter was built upon the recommendation of Samuel M. Gray, made to the city in 1910.

Hydraulicking Earth in Rhode Island

The removal of large quantities of earth by the hydraulic method has become quite common in the West, but is rather unusual in the East. It is being used this fall in Providence, Rhode Island, for removing a hill containing about 55,000 cubic yards of earth to make room for a new industrial plant at what is known as "Fields Point" in that city. The pumps for furnishing the water are driven by two 75-H. P. electric motors, and in the first eighteen operating days excavated 30,000 cubic yards. The material is being washed into a marsh adjacent to the site.

Two nozzles are being used, each passing approximately 1½ million gallons of salt water per day with a nozzle pressure of 175 lbs. per square inch. The contract is being performed by the Briggs Engineering Company, which started work about Sept. 15th.

Niagara Falls Power Tunnel

It is reported that the new power tunnel being constructed for the Niagara Falls Power Company, together with the power plant, will be completed next May. The main 33-foot tunnel has been excavated its entire length and remains only to be lined. When this tunnel has been completed, water will be turned into it and use of the present hydraulic canal temporarily discontinued so that improvements may be carried on in this canal. The total cost of the work will be approximately $11,000,000.

Electric Pumping at Concord*

By P. R. Sanders †

Comparison of cost of electric with steam power at the same plant shows the former to be less than sixty per cent of the latter.

The water supply of Concord, N. H., is obtained from Penacook Lake, which is two and one-half miles long and one-half mile wide, located about three miles from the center of the city.

The overflow is at an elevation of 125 feet above the business section of the city. From 1872, when the system was installed, until 1892, the total supply was furnished by gravity alone.

As the growth of the residential section extended westward into the higher parts of the city, it became apparent that steps must be taken to provide an increased pressure. In order to secure this increased pressure, in 1892 a high-service system was installed, consisting of a 2,000,000-gallon reservoir at an elevation of two hundred feet, and a 2,000,000-gallon Worthington triple-expansion pump.

In addition to using this high-service supply for the higher section of the city, a 20-inch main was laid through Main street for fire protection only, directly connected to this system, and this has later been extended to other business sections.

The pumping station is located between the city and the lake, on the main pipe line, about one mile from the center of the city and two miles from the lake, and is supplied by gravity at static pressure of 50 lbs., from an 18-inch cement-lined main and a 20-inch cast-iron main, which also furnish the gravity supply for the city.

In 1904, when the village of Penacook, a part of the city six miles north, was added to the high service, a second Worthington triple-expansion pump was installed. Up to this time the daily average amount of water pumped was 400,000 gallons, but after the addition of Penacook, it increased to 800,000 gallons. The total daily consumption for all purposes is nearly 2,400,000 gallons, 800,000 gallons from the high service and 1,600,000 from the gravity service.

In 1917, when the United States entered the war and coal was needed for the manufacture of munitions and other war supplies, it seemed best after a thorough investigation of the matter, to release the quantity of coal used to run our plant and pump by electricity.

In this respect Concord is very favorably located, for power is manufactured by the Concord Electric Co. at its plant at Sewall's Falls, and the line is also tied in with the Manchester

* Paper before the New England Water Works Association.
† Superintendent of Water Works, Concord, N. H.

Traction Co. at Garvin's Falls, both of these plants being located on the Merrimack river.

A rate was made by the Concord Electric Co. to the Water Works, by which they were to furnish us power at 1 1/3c per k. w. h. After we had paid $1,800 there was to be no further charge until we had pumped 300,000,000 gallons and then the rate was to be $6 per million gallons pumped, figured on a yearly basis. All pumping was to be done at night, between the hours of 8 p. m. and 6 a. m., except in times of fire or other emergency when we could pump as required.

A contract was made with the Worthington Pump & Machinery Corporation for an 8-inch single-stage horizontal split-case, double suction, volute pump, to have an efficiency of 72% when pumping 2,100 gallons per minute or 3,000,000 per 24 hours, against a net operating head of 120 feet.

To drive this pump, we furnished an A. C. 100 h. p. General Electric motor of the squirrel cage type, to operate at a speed of 1,800 r. p. m., which was guaranteed by the makers to have an efficiency of 91.5% when operated at either full or three-quarters load. A 20x8 Venturi meter was placed on the discharge main. The pump was placed in service in August, 1919.

As the water is taken directly from the mains that supply the city, provision had to be made to take care of the water hammer caused by the shutting down of the pump, and a 4-inch relief valve was placed on the suction to discharge into the sewer, set at an overload of 20%. The pump operates against a check valve on the discharge side as it is not necessary to start against a closed gate.

No addition or new building was necessary as there was ample room in the existing engine room.

The steam pumps are kept for emergency and the fireman is released for other duties. A small heating apparatus was installed to heat the engine room, as it was considered too expensive to use the large steam boilers for that purpose.

A test of the pump was made for the month of September, 1919, with a daily average of 654,333 gallons pumped, 340 k. w. h. used, and a net head pumped against of 126.4 feet, and the pump showed an efficiency of 85.18%.

During the year, 1920, the record of the electric pump by Venturi meter measurement was:

Water pumped, gallons	308,879,000
Daily average pumped, gallons	843,931
Gallons pumped per minute 2,640, or 3,800,000 per 24 hours	
Total K. W. H. used	156,610.
K. W. H. per 1,000,000 gallons	506.
Static head, suction, lbs.	50
Static head, discharge, lbs.	88
Dynamic head, suction, lbs.	37
Dynamic head, discharge, lbs.	90
Net head pumped against, feet	122

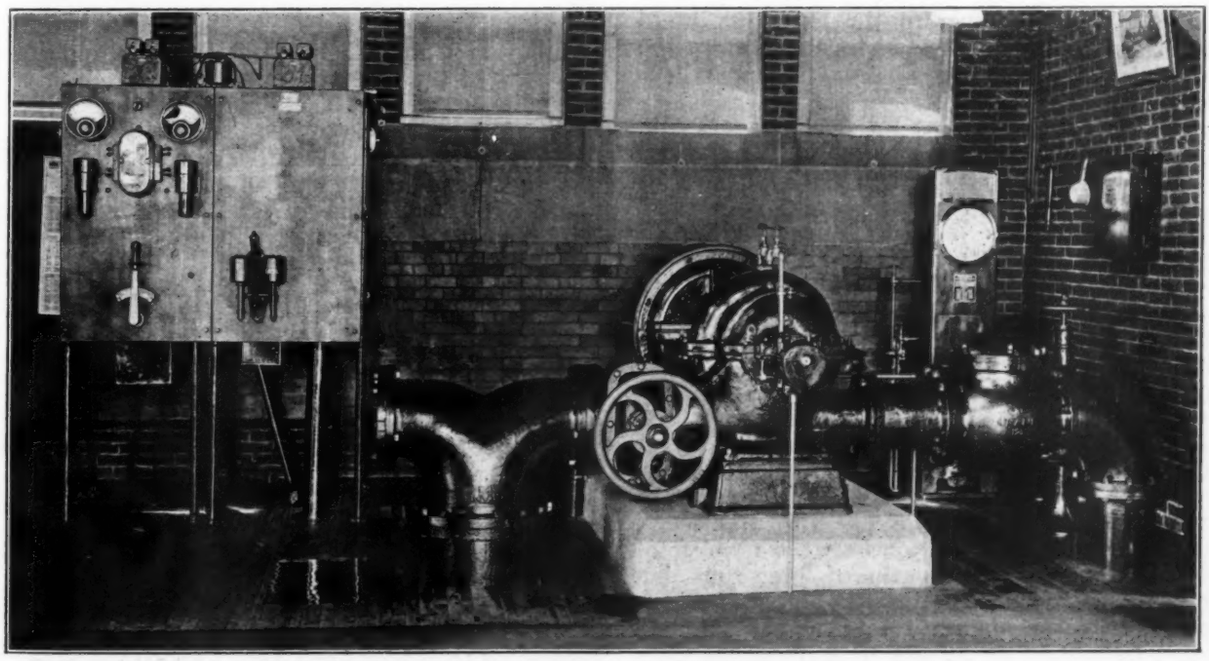
With switchboard loss of 2% and motor efficiency of 91½%, this gives an efficiency of 84.25%. The record for 1921 was equally good.

The cost of installation was as follows:

Centrifugal pump, foundations and fittings	$2,415.22
Motor and switchboard	1,291.50
Venturi meter	1,406.16
Heating apparatus	344.78
Total cost	$5,457.66

The supplies used for the past year were 14 gallons of oil, 47 pounds of packing, 74 pounds of waste and approximately 12 tons of coal to heat the building.

The cost of pumping by steam figured on total pumping station expenses with no allowance for interest or depreciation charges was:



ELECTRIC PUMP, CONCORD, N. H., WATER WORKS.

	per million gallons	
1911	$11.65	
1912	12.34	
1913	19.49	Excessive repairs
1914	13.12	
1915	14.02	
1916	15.40	
1917	16.22	
1918	17.06	
1919	15.14	Steam and electricity
Cost by electricity:		
1920	$13.16	per million gallons
1921	12.90	" " "

As wages and supplies were at least 33% higher in 1920 and 1921 than in 1918, it is fair to assume that the cost per 1,000,000 gallons pumped in those two years would have been $22.70, pumping by steam.

The total pumpage for 1920 and 1921 was 578,737,000 gallons which, if figured on the above basis, would present a saving of $5,590, by the change to electric power; and in addition, there is the advantage of the increased speed with which the pump can be started in case of fire.

Copper Sulphate in Hartford Water Supply

Experiences with its use for reducing algae in the reservoirs, resulting in lengthening filter runs. Methods of application.

The procedure and effect of applying copper sulphate to the reservoirs of the Hartford, Connecticut, water supply were described by J. G. Garrett, office engineer of the Hartford Board of Water Commissioners, in a paper before the convention of the New England Water Works Association.

Mr. Garrett stated that for several years copper sulphate had been applied to the various reservoirs of the system at seasons of the year when the micro-organisms became abundant, principally for the purpose of improving the taste and odor of the water.

Filtration was begun late in the Fall of 1921, and it was found that the use of copper sulphate lessened the amount of material which the filters have to remove from the water and thereby lengthened the duration of filter runs and, consequently, reduced the cost of operation. As a result of their experiences so far, the author believed that "presumedly we have not, as yet, got the whole story in regard to the amount of copper sulphate needed for effecting treatment, or in regard to the relation between number of micro-organisms and lengths of filter runs, but it is thought, from the information so far collected, that the application of copper sulphate has possibilities as an aid to economical filter operation with Hartford's water."

Hartford's older reservoirs are relatively small, and the copper sulphate has been applied to them by traversing them with a small boat equipped with an outboard motor, a bag of copper sulphate crystals being suspended over the side of the boat. The boat is rowed in a spiral course starting close to the shore and ending at the center, this course being determined wholly by experience and judgment. If, when the center is reached, it has been found that the pre-determined amount of sulphate has not been dissolved, an additional random course is followed with a view to spreading the remaining copper sulphate through the whole reservoir.

When it came to treating the large Nepaug reservoir, which required dissolving two tons or more of copper sulphate at a time, an eighteen-foot motor boat was employed. It was found by experiment that, with two bags of copper sulphate dragged through the water, one on each side of the boat, and the boat traveling at the rate of about six miles an hour, one hundred pounds of coarsely granulated copper sulphate would dissolve in five minutes. With this as a basis, it is possible to lay out courses over any portion of the reservoir which it is desired to treat so that the required amount of chemical can be dissolved in a more or less uniform manner. Ordinarily, courses are followed about 100 feet apart. The sulphate is well dispersed by the revolving of the boat propeller, which is one of the advantages of distribution by motor boat. Three men were carried in the motor boat, one to guide it and two to handle the sulphate bags. Since the sulphate dissolves much more rapidly when a bag is first immersed full, it was the practice to put a full new bag overboard on one side when the sulphate in the bag on the other side was about one-half dissolved.

The Nepaug reservoir was first treated on June 17, 1921. At that time the micro-organisms at the surface numbered 1300, and at a depth of thirty feet 350. Copper sulphate was applied to a part of the reservoir at the rate of 1.5 lbs. per million gallons. On June 21st, four days after treatment, the micro-organisms on the surface had been reduced to about 300. Some few small fish were found to have been killed by the treatment. There were certain coves in this reservoir which, in previous years, had been covered with a green algae scum, but none occurred in 1921 after the copper sulphate had been applied.

The new filters were started in operation in November, 1921, and until the middle of March, 1922, the number of micro-organisms did not average more than fifty, and the amount of water passed between scrapings was about 125,000,000 gallons per half-acre bed. Between March 17th and April 3rd high-colored bottom water was wasted from the Nepaug reservoir to prepare for the spring turnover, and water for the filters was meantime taken from the older reservoirs. The number of micro-organisms in these was somewhat higher than in the Nepaug, increasing to 185 by April 3rd. The rate of clogging during this short period indicated that the

quantity of this water that could be filtered between cleanings would average about 100,000,000 gallons per half-acre bed.

On April 3rd Nepaug water was again turned on to the filters, and by the end of the month the micro-organisms had increased to 150 or so, more than one-half being asterionella. Meantime, in the smaller reservoirs the micro-organisms had increased to 240 or 300, and they were treated with copper sulphate at the rate of 2.3 lbs. per million gallons early in May. Water meantime was being drawn from the Nepaug reservoir, and early in May this water began clogging the filters rapidly, runs of as little as 40 to 45 million gallons being the rule. On May 22nd Nepaug water was shut off so that the reservoir could be copper-sulphated, the number at that time totalling 300 at the surface and 200 at a depth of thirty feet. On May 23rd sulphate was applied to this reservoir at the rate of about 1.3 lbs. per million gallons, but produced no material results. The total organisms at the surface were not reduced at all in number, while those at thirty feet increased to about 600. About fifty per cent. of these organisms at this time were uroglena and thirty per cent. were asterionella.

Meantime the other reservoirs had been treated, and the micro-organisms fallen to between 50 and 100, and the filter runs lengthened to from sixty-five to seventy-five million gallons between washings.

As it was desired to use the Nepaug water as soon as possible, the same portion of the reservoir that had been treated before, that nearest to the intake, was again treated at the rate of about 2.3 lbs. per million gallons. Quite a few small fish were killed, but samples taken three days after treatment showed only slight reduction in the asterionella and practically none in the uroglena. The following day the micro-organisms at the surface were slightly less, but there had been a large increase at a depth of thirty feet, where they now averaged 1030 as against 600 on June 3rd. On June 9th Nepaug water was again turned on to the filters, being taken from the intake openings nearest the surface where the micro-organisms were lowest in number. On June 14th conditions had not improved, but by June 21st the surface counts had decreased to an average of 65 and an average of 100 at the 30-foot depth.

Certain other experiences during the summer were narrated by Mr. Garrett, some explainable and others not readily explainable. Apparently, as he stated in the quotation given above, there is yet considerable to be learned concerning copper sulphate treatment of micro-organisms in reservoirs.

Gas in Street Manholes

Gases of different kinds, mostly illuminating gas and that from gasoline, have been the cause of numerous accidents in the manholes of sewers and other underground structures, and a study of these gases is being made at the Pittsburgh, Pa., Experiment Station of the Bureau of Mines by S. H. Katz, assistant physical chemist and T. T. Bloomfield, junior analytical chemist. The aim is to determine the nature of the gases found in manholes and devise a practical test for determining the presence of them and means of preventing gas explosions.

Core Walls in Earth Dams

The Reclamation Service of the Department of the Interior has used several kinds of core walls and puddle cores in its dams. The walls are all of concrete, and are generally in comparatively thin sections. The highest in service at the present time is in the Strawberry dam in Utah, this core wall having a maximum height of about 70 feet above rock surface, or a total height of 85 feet above the bottom of the trench, the thickness varying from twelve inches at the top to a maximum of 48 inches at the bottom.

The Tieton dam, Yakima project, Washington, now under construction, will be the highest earth dam built by the Reclamation Service, being approximately 220 feet high. It will have both a concrete core wall and a hydraulic puddle core. The puddle core will have a maximum width of 70 feet at the base, and will be placed against the upstream face of the concrete core wall. The latter extends to a maximum depth of about 100 feet below the river bed, and will have a total height of about 320 feet. The foundation will be on andesite, except for a short length, which will rest on shale, this length having the footing spread out so as to limit the pressure due to the weight of the wall to eight tons per square foot, this footing being reinforced with 20-lb. rails spaced 12 inches centers. On the andesite foundation the maximum thickness will be five feet.

Only two dams have been constructed by the Service with puddle cores in the strict sense of the term, and these were constructed by hydraulicking, these being the Conconully dam and the Bumping Lake dam. The former has a puddle core eight feet thick at its base and five feet at the top, the height being about forty feet. The core in the Bumping Lake dam has a maximum height of sixty feet and widths varying from twenty feet near the bottom to two feet at the top.

Both these types of cores have proven adequately tight, and so far no trouble has developed due to saturation in the up-stream portions of the dams.

A most unusual core is that built by the Reclamation Service in the Sherburne Lakes dam as a means of draining the dam. It consists of a core of screened gravel ten feet thick at the bottom, about eighty-three feet high and five feet thick at the top, with side slopes of three in one hundred. This core is placed approximately under the down-stream edge of the crown and extends for the full length and height of the dam. The most impervious material in the dam is placed above the core, and the coarser below it. A cast-iron pipe with open joints is placed

in the bottom of the core and connects with transverse discharge drains, which lead the collected water into the stream. So far this construction has proven satisfactory, but it has not yet been thoroughly tested, as the water in the dam has reached only a head of forty-five feet, although it was designed for sixty-eight feet.

Street Lighting Construction and Apparatus*

By M. B. Hastings

Equipment necessary for both series and multiple systems, with underground or overhead construction. Control of lighting with time switches.

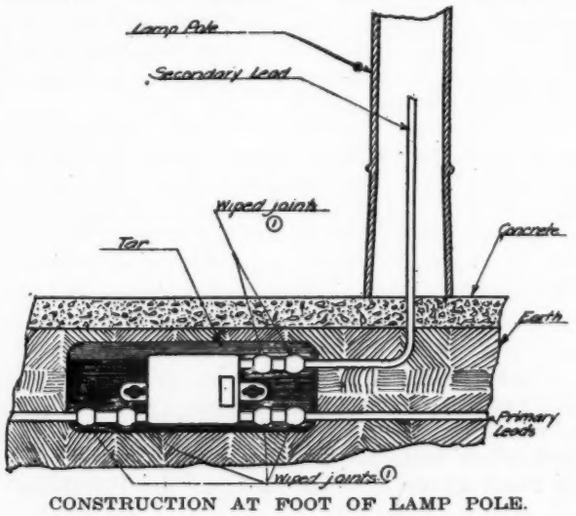
In general, street lighting is either series or multiple. In both systems the conductors are installed either underground or overhead. The overhead construction is most familiar and most common, although underground construction is best and is prohibited only on account of its cost. The cost can be very considerably lowered if foresight is used when the road is being made. Fibre conduit can be installed very cheaply if laid when the curb is being built. The one trench will do for both and in fact concrete equal to the volume of the conduit is saved.

The equipment necessary for a series system consists of a constant current transformer and panel board; or, an automatic constant current transformer. The cable of an underground series system should be No. 6 varnished cambric lead covered, with insulation depending on the voltage to ground. The voltage to ground depends entirely on the capacity of the constant current transformer and number of lamps in series. This cable is drawn through fibre conduit, imbedded in concrete, from one pillar to the next. Combination potheads and film cutouts were common, up to a few years ago; but now a series transformer at each pillar is considered best. By the use of a small series transformer at each pillar practically all the good points of both the series and multiple systems can be taken advantage of. The practice of mounting the series transformer in the base of the pillar has given way to that of burying it in the ground close to the pillar. So little trouble has been experienced with this type of construction that when the primary cable is properly jointed and wiped and the secondary leads are brought into the pillar, the series transformer is practically forgotten. A practical scheme is to make use of the packing boxes in which the series transformers come and fill with a cheap grade of pitch before permanently covering. Under operating conditions this gives a voltage on the pillar corresponding to the lamp in use, which is comparatively very low, approximately 25 volts in case of a 1000 candle power, 20 amp. lamp.

The series transformers have an efficiency of 93 plus per cent., a power factor slightly better than 98.5 per cent. and are made in almost any size desirable, although the standard sizes follow the standard lamp sizes. Where larger lamps are contemplated for future requirements, series transformers with a capacity greater than the immediate demands should be used. For instance the series transformers on the Sunnyside Boulevard in Toronto are capable of supplying 1000 candle power lamps, whereas the present installation consists of 600 candle power, 20 ampere lamps. This factor is an important one from the standpoint of lower efficiency lamps if such are ever obtainable. Where cheap current is available it seems unnatural to spend good money on high efficiency lamps to save that current. The intensity of illumination on the street should not be sacrificed and the ideal lamp for the purpose would be slightly increased in wattage to make up for the decrease in efficiency. The series transformer should have a capacity sufficient to take care of this.

The secondary of the series transformer should consist of No. 10, 600 volt, rubber insulated lead covered cable carried through an elbow conduit in the concrete base on which the pillar is mounted. The concrete base should consist of about ¾ of a yard of concrete for the ordinary sized pillar. Anchor bolts varying from ⅝-inch diameter in the case of the small park pillars, to ⅞-inch or 1-inch diameter in the case of the large white-way pillars should be used. The anchor bolts should be approximately 12 inches long, 8 inches of which should be in the concrete. The secondary lead covered leads of the series transformer should be long enough to reach the top of the pillar where they should be securely held independent of the socket.

In the case of Underground multiple systems, all the construction would be practically the same except the cable when 600 volt rubber insulated lead covered cable would be used. The leads to the lamp would be No. 10, 600 volt twin conductor weatherproof wire. The drop in



CONSTRUCTION AT FOOT OF LAMP POLE.

*Paper before Association of Municipal Electrical Utilities, slightly condensed.

voltage due to long runs of copper conductors is serious, and the size of the copper must be figured out accordingly. This is one of the disadvantages of the multiple system.

With either the multiple or series systems where crossings are encountered it is best to use a W.I. pipe and protect the end so water cannot get in and freeze. If the expense of lead cable in conduit is too great it is considered good practice to use steel armoured cable. In some multiple installations lead covered cable embedded only a few inches under the sidewalk and concreted in, has been used. The cable should be at least 12 inches underground and 6 inches where it is under a concrete sidewalk.

When overhead construction is used, the copper wires down the pole should be in conduit where possible. Up to 15 k.v.a. constant current transformers, where the secondary voltage does not exceed 2,500 volts, ¾-inch conduit should be used. Between 15 k.v.a. and 25 k.v.a. where the secondary voltage does not exceed 4,000 volts, 1-inch conduit should be used. Above 25 k.v.a. constant current transformers, the copper should be carried on pin type insulators. A distance of 9 inches from the pole is now advocated, so that the lineman need not come too near to it.

Protective devices are thoroughly recommended. Compression chamber multi-gap lightning arrestors are very good on the primary and the common horn gap lightning arrester is best on the secondary where the voltage is of an uncertain quantity.

We have dealt with methods of installations and protective devices and now let us discuss for a moment the control of a system. I am afraid time will not permit a discussion of the maintenance of a system, which after all largely depends on the engineer's personal attitude. Control of a system, however, is very important and it is essential that the predetermined schedule for the year be followed. This part of the patrolman's duties are generally neglected. Often as I go up and down the province I see street lights turned on long before time and still burning at eight or nine o'clock in the morning. Such is invariably the case when the system is not equipped with an automatic time switch. Even with time switches, the lighting schedule is not followed closely enough. The time switch should be set with respect to the schedule at least every week.

The Anderson electrically wound time switch is entirely automatic and will continue to operate as long as it is in good repair. It, however, has to be set periodically according to the lighting schedule. The electrical winding attachment is combined with a standard seven day clock, so there is no danger of the clock stopping on account of power being off for a few hours or days.

One of the most interesting developments in connection with automatic time switches is known as the season changing device for Anderson electrically operated switches. This is a great step forward in apparatus for controlling the time street lights are on, and a rather detailed description of this new device ought to be worth while and interesting.

When the time switch leaves the factory, the season-changing device has been adjusted for correct operation at the latitude where the switch is to be used, if known. Otherwise it is adjusted to the latitude of Boston—approximately 40 degrees north latitude. The latitude changing is done by lengthening or shortening of the cranks on the two small dials. This can be done by first loosening the center screws, when the cranks may be moved in or out, as required. This adjustment is difficult to accomplish, and should not be attempted in the field, but should be done before the switch leaves the factory.

After some time has elapsed between the date of shipment of switch and the time of putting the same in service, it will be necessary to adjust the season-changing device to the correct date when the switch is started to operate.

When correctly set, the instrument will follow the sunrise and sunset with a maximum error of about fifteen minutes from sunrise on August 15th and a similar error of fifteen minutes for sunset on May 15th, but will be practically correct on December 15th and June 15th.

Day Labor on Public Work

The Executive Board of the Associated General Contractors is interesting itself in the adoption by as many states as possible of legislation similar to that in force in Minnesota, which requires accurate and complete accounts of all public work or construction, to be open and available to the public.

This action has apparently originated in a belief by the contractors that a considerable amount of public work that is now being done by day labor should really be performed by the members of the Contractors Association, because it could be done at much less cost to the public in this way, and the belief that the public is not correctly informed as to the facts of the case. The Southern California Chapter of the A. G. C. reported that of 300 jobs done by day work in California, the cost could be determined of only five and on only two had bids been received from general contractors; while of these two, the cost in one had exceeded the low bid by 60% and in the other by 80%.

It was reported that in Illinois the law limiting the work done by day labor to $500 was evaded by splitting up the work into units, each having a cost of less than that amount, and the same is practiced in Utah.

The contractors believe that the public should know the exact cost of all public work done by force account and among the provisions of the law which they are advocating for passage by the different states are requirements that the estimated cost of each project be published at least fifteen days before the awarding of the contract, or the beginning of construction work where no contract is awarded; that bids should be received for every piece of work; that any

changes in plans or specifications during the construction be made public; that a time-limit be set on the time of publication of final costs; that the items included in the accounting fully cover the expense of equipment, depreciation, repairs, accounting, time of employees drawn from other departments, engineering and architectural service, and all other items connected with the work; and that the statement be audited by a certified public accountant and the actual cost published within ninety days after the substantial completion of the work.

Cement Pipe in Alkali Soils

Investigations made by U. S. Bureau of Standards show that best concrete will disintegrate under severe alkali attack.

The Bureau of Standards of the U. S. Department of Commerce has just published a progress report on investigations being made by it on the durability of cement drain tile and concrete in alkali soils. It is the result of inspection of experimental drain tile and concrete block installation at eight alkali projects in the west. The investigation was begun in 1913 and this report, although published only a few weeks ago, includes the investigations through 1920 only.

"The conclusions to date are that the best quality of concrete will disintegrate when exposed to severe alkali attack, and that installations of concrete in soils containing more than 0.1 per cent. of salts of the sulphate type should be preceded by an examination of surrounding conditions." The report contains tables and other details of the data obtained, together with illustrations showing the effect of alkali on cement pipe of different compositions and manufactured under various conditions.

In summing up the results, the investigators conclude that "durability of drain tile for any given concentration appears to vary with richness of mix and consistency. Hand-tamped tile are less resistant to action than machine-made tile made of the same mortars." "As a class it may be said that wet mix tile have been much less affected by alkali action than dry mix tile."

"Inspection of drain tile and structures in other localities where the alkali salts are of the chloride or carbonate types seem to justify the conclusion that these waters are not so severe as waters of the sulphate type which are found in all our drains in the alkali districts." Water flowing in drains very frequently has less acid concentration than that in soil surrounding the tiles. "In all cases where disintegration of the best quality of tile has occurred, samples of the soil immediately in contact with such tile have revealed concentrations much higher than are indicated by the drain water."

The investigating engineers have concluded that "the work to date has consistently emphasized certain precautions which should be observed by any one using cement under such conditions" (exposure to alkali soils and waters).

The conclusions from the investigations concerning cement drain tile are as follows:

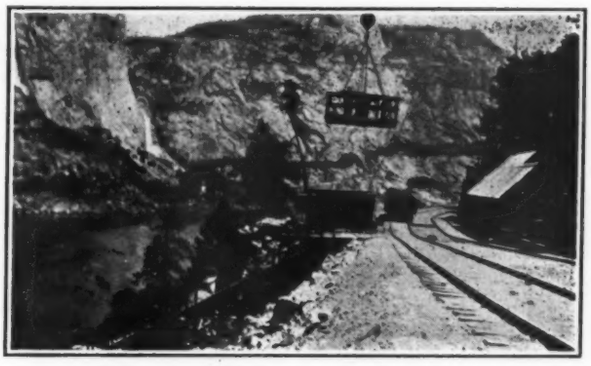
1. The use of concrete tile in soils containing alkali salts of the sulphate type in considerable quantities is hazardous, in view of the fact that the best quality of drain tile has been disintegrated during an exposure of less than six years.
2. Porous or permeable tile, due to the use of lean mixtures, or relatively dry consistencies, are subject to disintegration in sulphate waters of relatively low concentrations.
3. Dense tile of the best quality, exposed to sulphate waters are under certain conditions subject to disintegration, depending upon concentration of salts in seepage water, and alkali and moisture conditions in the soil immediately surrounding the tile.
4. Disintegration may be manifested in sulphate waters by physical disruption caused by expansion resulting from the crystallization of salts in the pores, but it is primarily due to chemical action between the salts in solution and the constituents of the cement. In the case of dense tile of low permeability exposed to sulphate waters, disintegration may occur at or just inside the surface skin and progress into the wall of the tile.
5. A thin outer skin of apparently unaffected concrete is apparent in the case of disintegration of the best quality of tile. While this relatively thin layer may be either immune to attack by salts in solution, or perhaps be very slowly attacked, results indicate that this carbonized coating is not in itself waterproof, and alkali water may pass through this coating into the mass.
6. In sulphate waters with a concrete or mortar of given quality the disintegration effect seems to vary with the concentration of the solution.
7. Tile made by the process commonly used, which allows the removal of forms immediately after molding, are more susceptible to disintegration where exposed to sulphate soils or waters than are tile made of wetter consistency which requires their retention in the molds for a period of hours.
8. The use of hand tamped tile of plastic consistency, such that the jacket can be removed immediately after molding, can not be recommended for use in sulphate soils and waters. Tile of plastic consistency, molded in the packerhead type of machine, are more resistant to alkali action than the hand tamped tile, but the best quality of packer-head machine tile have been affected in waters of high salt concentration.
9. Steam cured tile show no greater resistance to alkali action than tile which are cured by systematic sprinkling with water.
10. Tile made of sand cement have less resistance to alkali action than tile made of Portland cement of the same proportions.
11. The tar coating as used was not effective in preventing the absorption of alkali water into the walls of the tile.
12. The cement-grout coating is not effective in preventing the absorption of alkali water.
13. No advantage was found in introducing ferrous sulphate into the cement mixture. The use of this material resulted in a reduction of the crushing strength of the tile.
14. If cement drain tile are to be used in soils and waters containing 0.1 per cent or more salts of the sulphate type, their installation should be preceded by an examination of subsurface alkali conditions. Decision as to the advisability of using cement drain tile should be based upon thorough examination of subsurface conditions and quality of product which it is proposed to use, and upon a comparison of the data so obtained with the data presented in this report. Such an examination may indicate portions of an area where the use of cement tile should be avoided. Quantities

of alkali salt present can be determined by chemical analyses of the soils. Concentrations to which tile may be exposed can be determined by chemical analyses of the ground waters. In drawing conclusions allowance must be made for the constantly changing concentrations of alkali in the seepage water, which at times may differ as much as several hundred per cent in adjacent areas. There can be no assurance that the concentrations found at any time are the maximum to which the tile will ever be exposed. Quality of cement drain tile can best be measured by permeability tests. With other conditions equal, tile of lowest permeability will be the most durable. There appears to be little definite relation between permeability and the related factors of porosity, absorption, and density.

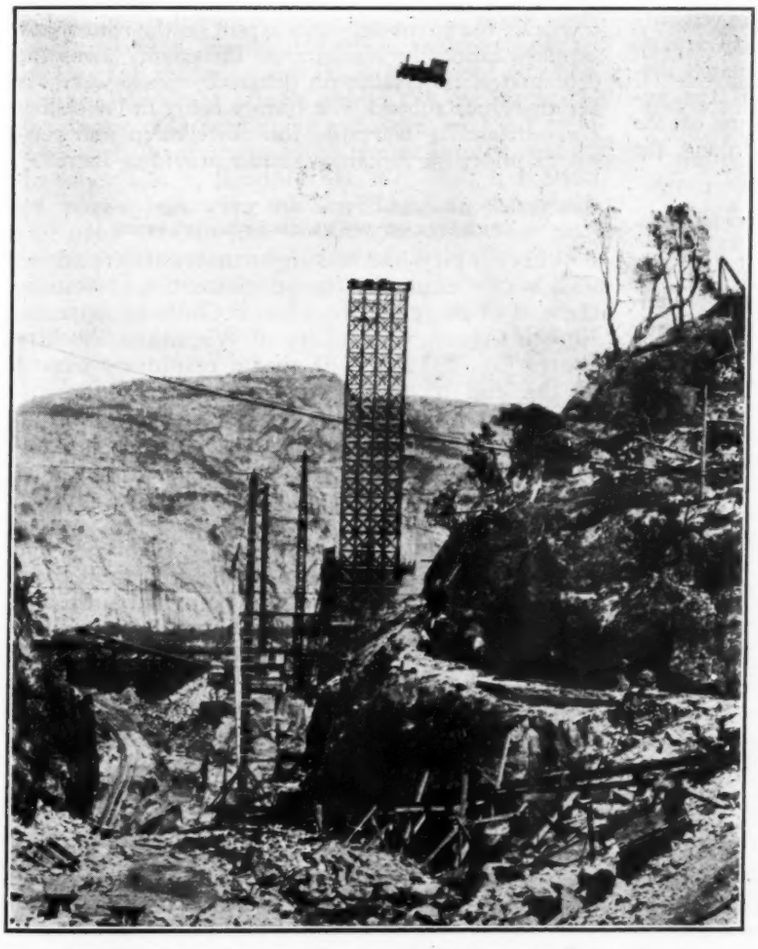
Handling Men by Cableway

In constructing the Hetch Hetchy dam for San Francisco the contractor, the Utah Construction Company, used inclined railways and steel derricks for removing the excavated materials, but later installed a Lidgerwood cableway for transferring material to the bottom of the foundation pit. (The dam and construction details have been described in PUBLIC WORKS for July 22 and earlier issues.)

The contractor established a camp about a quarter of a mile from the dam site and 500 feet above the bottom of the foundation pit. At the beginning of operations the men descended into the pit in a car operated on an incline by a hoisting engine. Later this was replaced by a cableway and trolley hoist with a skip carrying 40 men that could make one trip in three minutes. The same cableway was used for lowering an 18-ton locomotive from the tracks of the Hetch Hetchy railroad to the level of the stream bed.



CAR SUSPENDED FROM CABLEWAY TROLLEY TO LOWER 40 MEN AT ONCE 500 FEET IN EXCAVATION.



LOWERING 18-TON LOCOMOTIVE FROM HIGH LEVEL TRACK TO 117-FOOT EXCAVATION BY CABLEWAY.

Cooperation for Public Utilities

California voters are asked to vote on a number of State measures, one of which is a bill that would authorize contracts between two or more municipalities for joint action in the acquisition, construction or operation of public utilities or other municipal affairs of common concern, and if bonded indebtedness is involved a two-thirds favorable vote is required. If the vote be favorable, the contract must then be approved or rejected by the Legislature in the same manner as charter amendments and would be subject to future amendment or termination by the vote of the communities participating. This measure is endorsed by the San Francisco Bureau of Governmental Research. It certainly does not appear to make too easy the co-operation of municipalities in carrying out public utilities.

A charter amendment, which is also endorsed by the bureau, is one that would permit the expenditure of money by San Francisco for highways outside the city and county when they are authorized by the county, the funds to be expended by a duly constituted body authorized to construct the highway. While this would be a general provision, it is intended especially to provide for a proposed highway to be constructed by a joint district commission authorized by the state law.

Recent Legal Decisions

PUBLIC WORKS CONTRACTS AWARDED IN FRACTIONS ACCORDING TO GROUPING OF BIDS

Under a statute providing for written contracts for public works with the lowest and best bidder after advertisement, the Circuit Court of Appeals, Sixth Circuit, holds, O'Reilly v. City of Cambridge, 279 Fed. 961, that where it is contemplated that the contract would be awarded in fractions according to discretionary grouping of the fractional bids, the right of the director of public service to reject any and all bids gives him the right to accept part and reject part of one bid, provided that it does not result in the separation of items which are necessarily associated. If the successful bidder upon most of the items is awarded the contract upon condition that he will also assume an item upon which he did not bid, and will do so at a price by which the city will not be prejudiced, every requirement intended for the safety of the city has been met by the public advertisement and the reception and consideration of all the bids made.

DUTY TO HAVE TEMPORARY SIDEWALK OBSTRUCTIONS LIGHTED

The Louisiana Supreme Court holds, Lemoine v. City of Alexandria, 92 So. 58, that cross ties placed over a mudhole in a sidewalk, presenting uneven surfaces to pedestrians, were obstructions to travel, even though they were in a sparsely populated district and were placed there by request of the immediate neighborhood; and it was the duty of the municipality to maintain sufficient light along the sidewalk to protect those using it.

CITY HELD UNAUTHORIZED TO MAKE UNCHANGEABLE RATES FOR SEWER COMPANY

Section 22 of the Alabama Constitution provides that "every grant or franchise, privilege, or immunity shall forever remain subject to revocation, alteration, or amendment." The Federal District Court for Alabama, M. D., holds, Opelika Sewer Co. v. City of Opelika, 280 Fed. 155, that under this provision the Legislature cannot authorize a municipal corporation to make a contract fixing unchangeable rates to be charged by public utilities. Where a sewer company was given a franchise to operate in a city for 30 years and to charge rates not in excess of specified amounts, and where it was shown that the rates were inadequate to afford a fair return upon the value of the company's property employed in the service, no dividend having ever been paid, the rates were held to be confiscatory and unenforceable.

COUNTY'S DUTY AS TO RETENTION OF PART OF CONTRACT PRICE TO SATISFY LIENS

The Washington Supreme Court holds, Aetna Casualty & Surety Co. v. Skagit County, 207 Pac. 237, that a county which pays out to the bank which financed the contractor the 20 per cent. of the contract price which the contract provided should be retained to satisfy liens without the consent of the bonding company and while other claims are unsettled, will be liable to the bonding company for the claims which could have been paid out of the fund. Where the contract provided that the contractor should show to the satisfaction of the county that all just debts due for labor and material had been paid, it was not sufficient compliance with this provision to make the final payment on the verbal statement of the contractor alone, without an investigation.

The Circuit Court of Appeals, Sixth Circuit, holds, O'Reilly v. City of Cambridge, 279 Fed. 961, that where proposals for bids provide that before final payment on the contract the contractor shall give bond for maintenance for a specified period, the omission from the contract for the work of a provision for such a bond does not dispense the necessity for giving it.

ISSUE OF COUNTY ROAD WARRANTS PAYABLE IN FUTURE HELD UNCONSTITUTIONAL

The Arkansas Supreme Court holds, A. L. Greenberg Iron Co. v. Wood, 240 S. W. 1074, that a county has no power to issue road warrants payable in the future, and a statute providing that a county may issue such warrants is unconstitutional. The object of this statute was to pay certain holders of county road warrants a sum equal to a stipulated rate of interest for their forbearance in presenting the warrants for payment. A warrant on the county for supplies cannot be issued until the county owes the debt and it is payable on demand. Such warrants are therefore subject to a county court order calling for outstanding warrants for cancellation and reissuance under the Arkansas statute providing therefor.

QUESTION OF ELECTION BY CITY OF OPTION TO PURCHASE WATERWORKS SYSTEM

Where a city had the right under its franchise to a water company, to purchase the system at the end of 20 years, the Circuit Court of Appeals, Eighth Circuit, holds, City of Wichita v. Wichita Water Co., 280 Fed. 770, that a resolution passed at the end of that time providing for the appointment of appraisers to value the system so that the proposition of purchase might be submitted to the vote of the citizens, and correspondence with the company on the subject, did not constitute a contract which the water company could have specifically enforced, the court being of opinion that the mayor and commissioners never intended on their own authority to purchase the system. The court distinguished the case of Castle Creek Water Co. v. City of Aspen, C. C. A., 146 Fed. 8, where there was such an arbitration clause in the water company's franchise, and where the city had actually given notice, one year in advance of the expiration of the franchise, as thereby required, of its intention to purchase the system.

COUNTY HELD NOT ENTITLED TO RECOVER BACK MONEY PAID FOR ROAD REPAIR MATERIAL IN EXCESS OF SPECIFICATIONS

A county entered into a contract, after advertisement for bids, for "approximately 50,000 gal-

lons of tar" for repair of a road. The specifications provided: "But in no case shall the total be increased or diminished more than 25 per cent. of the estimated amount required." 25,408 gallons in excess of the maximum amount so specified was used on the road, amounting to $4,509.92, under the direction of the supervisor of roads, without any additional advertisement or supplemental contract. The bill therefor was audited, approved and paid by the county, which subsequently sued to recover it back, on the ground that it was an illegal and void payment. The New Jersey Supreme Court holds, Mercer County v. Tobish, 117 Atl. 392, that the county could not recover back the amount of the excess payment, under the rule, applied in prior specified cases in that jurisdiction, that where a municipal corporation has the right and power to enter into a given contract, it can legalize it after it has been performed under the authority of its unauthorized agents, and convert the money so earned into a legal debt.

LIABILITY FOR LETTING PUBLIC WORKS CONTRACT WITHOUT BOND TO PAY FOR MATERIAL AND LABOR ONLY ATTACHES ON INSOLVENCY OF CONTRACTOR

The Minnesota Supreme Court holds, Fargo Cornice & Ornament Co. v. School Dist. No. 88, 188 N. W. 733, that the liability imposed by Section 8246, Minn. Gen. St. 1913, on a municipality which lets a contract for doing public work without taking a bond to secure the payment of claims for material and labor furnished the contractor, does not attach unless the contractor be insolvent, and cannot be enforced without proving such insolvency. The court quotes Wilcox Lumber Co. v. School Dist. No. 268, 103 Minn. 43, to the following effect: "The fact that plaintiff presented its bill to the contractor for payment and that he did not pay it is far from conclusive that he could not pay it, or could not have been compelled to do so by appropriate legal proceedings."

CITY HELD NOT LIABLE FOR ITS NEGLIGENCE OR THAT OF ITS SERVANTS IN REGARD TO INSTRUMENTALITIES IN PUBLIC PARKS

The park commission of the city of Virginia, Minnesota, maintains a slide in a public park of the city. In using it, one was injured because of an alleged defect therein, and sued the park commission and the city for damages. The Minnesota Supreme Court, Emmons v. City of Virginia, 188 N. W. 561, stated the controlling question in the case to be: Is a city which equips its public parks with instrumentalities for diversion and exercise, for the free use of its inhabitants, liable in damages to one injured in their use because of negligent construction or maintenance? In some states this question has been answered in the affirmative, in others, in the negative. The court mentioned in its opinion as holding that liability exists, the courts of Colorado, Delaware, Oklahoma and Pennsylvania; and as holding nonliability of the city, Kansas, Kentucky, Massachusetts, Michigan, New Jersey, Rhode Island, Tennessee and Wisconsin. Whether these courts rendered their decisions on facts and statutes similar to those here involved the Minnesota court did not enquire.

The court takes the view of nonliability, on the ground that "cities, through park and school boards, have of late provided playgrounds equipped with various instrumentalities for exercise and amusement. Where this is done for the public good and gratuitously, the cities and their servants are to be regarded as agencies of the government, and are not acting in a proprietary character." There was no allegation that the commission or the city charged a fee for using the slide or derived income from equipment furnished for the public amusement. In this respect such a case differs from those where the city undertakes to furnish water or light to individuals for a price. And no allegation of the complaint brought the slide within the definition of a nuisance.

CARE REQUIRED IN USING CONCRETE MIXER IN STREET

The California courts hold, Jackson v. Leonardt & Peck, 207 Pac. 500, that the maintenance of a concrete mixer in a street under a regular permit from the city authorities, which stood close to the curb, about 100 feet from a street intersection, with the hopper raised, in which position it would be less of an obstruction than if lowered, was not negligence rendering the contractor liable for injuries to an automobile which was driven into it in broad daylight. A barricade around the mixer was not necessary, and could merely have added to the obstruction without giving any better notice of the presence of the mixer than did the latter itself. The contractor was, of course, under a duty to place the machine so that it would not unnecessarily obstruct travel, or be likely to produce injury to those who, using reasonable care, might travel upon the street.

ZONE SYSTEM OF ROAD IMPROVEMENT ASSESSMENTS APPROVED.

The Arkansas Supreme Court, Desha Road Improvement Dist. No. 2 v. Stroud, 241 S. W. 882, holds that the zone system of road improvement assessments is not an improper method if it is determined upon by the commissioners in the exercise of judgment, after considering all the elements affecting the benefits.

PROPERTY OWNER CAN BIND HIMSELF BY CONTRACT TO PAY CONTRACTOR FOR STREET IMPROVEMENT.

In an action by a construction company against an abutting owner on a special assessment certificate issued for the paving and improvement of of a street and on a contract signed by the owner, it appeared that the contract required the work to be constructed in accordance with the plans and specifications adopted by the city and set out in the contract between the city and the contractors. The question whether the paving was so constructed was submitted to the jury, which answered "Yes." The Texas Court of Civil Appeals holds, Cannon v. Healy Const. Co., 242 S.

W. 526, that the construction company was legally entitled to recover upon the promise contained in the owner's written contract. The owner could legally make a personal contract concerning the improvement in the street.

CITY CHARTER AND ORDINANCES FIXING MINIMUM WAGES FOR PUBLIC WORK HELD VALID

The Washington Supreme Court holds, Jahn *v.* City of Seattle, 207 Pac 667, that the charter provisions of Seattle and its ordinances providing that contractors for improvement work for the city shall pay employees thereon not less than the current wages paid by the city for such work, and not less than a specified amount, and shall give preference to citizens who are heads of families, are valid even if the wages be unreasonable, the validity of such statutes and ordinances not being dependent upon the exercise of the police power, which must be reasonable. Citing Malette v. Spokane, 77 Wash. 295, the court said: "The state and the various municipalities within it have the right to say that public work shall be done in any manner, at any price, and upon any terms which they see fit to lay down. It is in the power of the state and of its subsidiary municipalities to say that public work shall not be done, or that it may be done, and in the latter case it can prescribe the terms and conditions upon which it will allow it to be proceeded with. These are matters which the people have the right to determine for themselves, without interference by the court, after they have spoken their will, as here, by the adoption of a charter and the passage of ordinances by their legislative representatives. The courts no more will attempt to say what wages must be paid upon public work, what hours of employment shall prevail, or the class of people who shall perform that work, than they will attempt to interfere and prescribe the material to go into the work, the manner of construction, or other engineering details of a public improvement."

CONSTRUCTION OF ACT AUTHORIZING ISSUE OF WARRANTS TO PAY FOR CONSTRUCTION AND MAINTENANCE OF PUBLIC ROADS.

The Alabama Supreme Court holds, Court of County Comrs., De Kalb County v. McCartney, 92 So. 439, that Ala. Acts 1920, p. 10, §§ 1, 8, authorizing a court of county commissioners of any county to issue interest-bearing warrants for settlement of any debt or obligation incurred in construction or maintenance of public roads, gives such court no power to issue and sell such warrants, with interest coupons attached, payable in the future, to raise cash to make an appropriation for the purpose of constructing public roads.

CONTRACTS BY STREET RAILWAY COMPANIES TO REPAIR OR REPAVE STREETS

One of the customary requirements found in grants by municipalities to street railways to occupy the streets is the obligation by the company to repair or repave the streets occupied; though irrespective of any contract it is bound to keep in condition the portion of the highway used by it. The Pennsylvania Supreme Court holds, Borough of Collingdale v. Philadelphia Rapid Transit Co., 117 Atl. 909, that where, in consideration of the franchise, the company has agreed to make the necessary improvements, the terms of the contract must be complied with until it has, by some recognized legal method, been formally released from the agreed obligation, if the right to occupy the street is to be retained, and this liability extends to a merged or leasing company; and the duty may be enforced specifically, or the required work may be done by the municipality, and the cost thereof collected from the railway company. A statutory provision that no contract between a municipality and any public service company shall be valid unless approved by the public service commission, made effective upon the passage of the act, does not apply to contracts entered into before that time.

PROCEDURE WHERE NO BIDS FOR STREET IMPROVEMENT RECEIVED—COST AS FIXING NECESSITY FOR ADVERTISEMENT

The Kentucky Court of Appeals holds, City of Tompkinsville v. Miller, 241 S. W. 809, that where a statute empowers a city to construct a street and require the abutting owners to pay a proportion of the cost, the fact that the work was advertised and offered for contract with the lowest and best bidder, and no bids were received, does not entitle the city to have the work done through a committee or agent, and then impose the cost of it upon the abutting property; in such case it must abandon the project, or else have the improvement made and pay for it out of the general fund.

It is also held that where the necessity of advertising for bids is determined by the cost of a street improvement, it is the cost of the entire improvement, not the portion of the cost assessed against the lands in controversy which is to be considered, since the statutory provision fixing the limit cannot be evaded by splitting the work into sections.

MUNICIPALITY MAY DISPOSE OF PROPERTY OWNED BY IT NOT APPROPRIATED TO PUBLIC USE.

Property owned by a city for governmental purposes and appropriated for the public use is impressed with a trust and cannot be disposed of, except by valid legislative authority. As a general rule, however, a municipal corporation, unless restricted by its charter, or by statute, has the power not only to acquire property, real and personal, but, where not appropriated for the public use, may alienate the same just as other corporations or individuals might do. Where property is acquired or held for a special purpose, as soon as that purpose is served, and the corporation has no further use for the property, it may be converted to another use, or disposed of by the municipality.—City of Williamsburg v. Lyell, Virginia Supreme Court of Appeals, 112 S. E. 666.

WHAT A VOTE OF MAJORITY OF QUALIFIED ELECTORS OF A CITY MUST INCLUDE.

The Kansas Supreme Court holds, Clayton v. Hill City, 207 Pac. 770, that a provision of the statute authorizing cities among other things to construct a transmission line to obtain electricity from a plant outside its boundaries that no bonds shall be issued under it except upon "a vote of a majority of the qualified electors of such city" means that those voting in favor of the bonds must form a majority of all entitled to vote at the election, and not simply a majority of those voting thereat.

NEWS OF THE SOCIETIES

CALENDAR

Nov. 18—4-STATE SECTION, AMERICAN WATER WORKS ASSOCIATION. meeting in Baltimore, Md. Secretary, C. R. Wood, P. O. Box 363, Philadelphia, Pa.

Nov. 21—PROVIDENCE SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Providence Engineering Society. Secretary, W. A. Kennedy, 301 W. Exchange Street, Providence, R. I.

Nov. 28 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, E. A. Brooks, 702 Candler Bldg., Atlanta, Ga.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

Dec. 14-15—KANSAS ENGINEERING SOCIETY. Annual meeting in Chamber of Commerce rooms, Topeka. Secretary, J. M. Averill, Topeka, Kansas.

Jan. 11-12—AMERICAN ENGINEERING COUNCIL. Annual meeting at new headquarters of F. A. E. S., 24 Jackson Place, Washington, D. C. Secretary, L. W. Wallace, 24 Jackson Place, Washington, D. C.

Jan. 11-12 — FEDERATED AMERICAN ENGINEERING SOCIETIES. Annual meeting, Washington, D. C.

Jan. 15-17—NATIONAL CRUSHED STONE ASSOCIATION. Annual convention at Chicago. Secretary, A. P. Sandles.

Jan. 15-18 — AMERICAN ROAD BUILDERS ASSOCIATION. Annual convention, Chicago.

Jan. 17-18—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting, 29 West 39th Street, New York City. Secretary, John H. Dunlap.

Jan. 22-26—AMERICAN CONCRETE INSTITUTE. Annual convention, Cincinnati.

Jan. 23-26—IOWA ENGINEERING SOCIETY. Annual Meeting in Des Moines. Secretary, Lloyd A. Canfield, 406 Flynn Building, Des Moines.

Jan. 30-Feb. 3—ASSOCIATED GENERAL CONTRACTORS OF AMERICA. Annual meeting, Los Angeles, Calif.

May 7-9—AMERICAN ASSOCIATION OF ENGINEERS. Ninth annual convention, Norfolk, Va. Secretary, C. E. Drayer, Chicago.

May 21-25 — AMERICAN WATER WORKS ASSOCIATION. Annual convention, Statler Hotel, Detroit, Mich. Secretary, John M. Diven, 152 West 71st Street, New York City.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS

The eighth annual meeting of the American Association of State Highway Officials will be held at the Baltimore Hotel, Kansas City, Mo., on December 4th to 7th, inclusive. The most important feature of this meeting will be the group meetings, where sub-committee discussions will be held covering plans and surveys, design, specifications, traffic control and safety, and bridges and structures. These discussions are to take place during the afternoon of Dec. 4th and no general sessions will be held at this time. There will also be meetings of the Committees on Administration, Construction, Motor Truck Regulation, Maintenance, Standards, Tests and Investigations, and Publications.

On Dec. 4th a paper will be read by A. R. Hirst, state highway engineer of Wisconsin, entitled, "Troublesome Problems Encountered in the Administration of a State Highway Deparment." On Dec. 5th A. B. Fletcher, state highway engineer of California, will deliver an address on "Financing Construction and Maintenance on a State Highway System," and Clifford Older will speak on "The Service Tests of the Bates Road—a Step Toward the Rational Design of Roadway Surfaces." T. E. Stanton, assistant state highway engineer for California, will give the conclusions derived from studies of the effect of traffic on the Pittsburgh, California test road as they affect the design of pavement sections. Bridge design will be considered on the evening of Dec. 5th, the principal paper being by L. N. Edwards, bridge engineer of the Maine State Highway Commission. Additional papers will be read by C. N. Connor, assistant engineer of the North Carolina Commission, and C. B. McCullough, bridge engineer for the Oregon Commission.

On Dec. 6th Thomas H. MacDonald, Chief of the U. S. Bureau of Public Roads, will discuss "The Functioning of the Federal Aid Policy," and "The Handling of Federal Aid from the State Point of View" will be discussed by Rollen J. Windrow, consulting engineer to the Missouri Highway Commissioner. In the afternoon John H. Mullen, deputy commissioner of highways for Minnesota, will present a paper entitled, "A Construction Division, Its Financing, Organization and Operation"; and "The Field Control of State Highway Maintenance Work" will be discussed by G. C. Dillman, deputy commissioner of the Michigan State Highway Department.

The election of officers and receiving of committee reports are on the program for the morning session of Dec. 7th.

GOOD ROADS CONGRESS AND SHOW

The arrangements for the Thirteenth American Good Roads Congress and Fourteenth National Good Roads Show, to be held in Chicago on January 15th to 19th, are in the hands of an organization which was formed after this year's Congress and the revision of the Constitution and By-Laws. The exhibitors at the last show formed an organization known as the Highway Industries Exhibitors Association, while the Executive Committee of the Road Builders Association appointed a Special Convention and Show Committee to have supervision of all arrangements for the Congress. This committee consisted of C. M. Upham as chairman and James H. MacDonald, both representing the A. R. B. A., and S. F. Beatty, who is president of the Exhibitors Association. This General Committee has created a number of sub-committees on program, reception and hotel, entertainment, registration, exhibits, banquet, local press, transportation and general publicity. Each of these sub-committees will be composed of active members of the Road Builders organization who have had experience with past expositions and conventions.

At first the Exhibitors Association felt that, without co-operation with the A. R. B. A., it would be better to undertake the Road Show independently of the other Association, but the latter association asked for one more year in which to demonstrate its ability to handle the show as it should be handled, and this was agreed to with the condition that a Director of Exhibits should be appointed who would be an experienced man and not connected with either association; that the sessions of the convention should not be held in the Coliseum, since that necessitated too frequent shutting down of the machinery during the meetings of the A. R. B. A.; and that an audit of the Road Builders Association should be prepared so that the Exhibitors Association could learn how the surplus was being used.

In carrying out this agreement, the Exhibits Committee has employed C. W. Kelly of Chicago as Director of Exhibits and C. S. Lee of New York as Director of Publicity. Mr. Lee handled the publicity work for the 1921 and 1922 conventions and shows, while Mr. Kelly has staged some of the biggest expositions in the country.

According to Chairman Upham, the chief difficulty will be in providing space for all the exhibits offered, although arrangements will be made for all the additional space that it is possible to obtain.

Mr. Upham states that the program for the Congress will be entirely different from previous ones, in that, instead of avoiding controversal subjects as in the past, the program will consist of such subjects of vital interest to the whole road-building industry. It is expected that this will heighten the interest in the sessions and provoke informative oral discussions.

The general offices of the American Road Builders Association have been moved from 11 Waverly Place, New York, to 37 West 39th Street, in that city. The headquarters of the Highway Industries Exhibitors Association is at 400 North Michigan Boulevard, Chicago.

A. S. M. E. SECTIONAL MEETINGS

During November there will be meetings of local sections of the American Society of Mechanical Engineers, at least two of which will discuss subjects of interest to public

works engineers. One is a meeting of the Providence, R. I., section jointly with the Providence Engineering Society, at which an address on "The Engineer and the Home" will be given by Mrs. Frank B. Gilbreth, of Montclair, N. J.

The other will be the meeting of the Atlanta Section at the Town Hall in Atlanta, where R. H. Cunningham, southern representative of the Ingersoll-Rand Co., will speak on "Diesel and Semi-Diesel Engines vs. Small Steam Engines in Power Stations up to 500 k. w," which subject will be discussed by R. B. Hall of the Ames Iron Works and W. H. Davidson of the Fulton Iron Works.

NEW ENGLAND WATER WORKS

The Nominating Committee has submitted the following list of nominees for officers to serve during 1923: For President, Percy R. Sanders, Superintendent of Water Works, Concord, N. H.

For Vice-Presidents, Geo. A. Carpenter, City Engineer, Pawtucket, R. I.; Reeves J. Newsom, Commissioner of Water Supply, Lynn, Mass; David A. Heffernan, Superintendent of Water Works, Milton, Mass.; Frank E. Winsor, Chief Engineer Board of Water Supply, Providence, R. I.; Theodore L. Bristol, President and Manager, Ansonia Water Co., Ansonia, Conn., and Vernon F. West, Treasurer and Manager of Water Companies, Portland, Me.

For Secretary, Frank J. Gifford, Superintendent, Dedham Water Company, Dedham, Mass.

For Treasurer, Frederic I. Winslow, Division Engineer, Metropolitan Water Works, Framingham, Mass.

For Editor, Henry A. Symonds, Consulting Engineer, Boston, Mass.

For Advertising Agent, Fred O. Stevens, Superintendent of Water Works, Weymouth, Mass.

For additional members of the Executive Committee, Frank A. Marston, Consulting Engineer, Boston, Mass.; Stephen H. Taylor, Superintendent of Water Works, New Bedford, Mass., and Geo. A. Sampson, Consulting Engineer, Boston, Mass.

For Finance Committee, A. R. Hathaway, Water Registrar, Springfield, Mass.; E. D. Eldridge, Superintendent Onset Water Co., Onset, Mass., and Arthur N. Birnie, Superintendent Biddeford & Saco Water Co., Biddeford, Me.

ASSOCIATED GENERAL CONTRACTORS

The Executive Board has announced the nominations for next year's officials as follows: For president, W. E. Wood, president of the W. E. Wood Co. of Detroit; for vice-president-at-large, A. P. Greensfelder, secretary of the Fruin-Colnon Contracting Co. of St. Louis; for vice-president, Zone 4, J. H. Ellison, vice-president of Winston-Dear Co. of Minneapolis; for directors, James E. Cashman, Burlington, Vt., Frederick Ward, Brooklyn, N. Y., W. F. Creighton, Nashville, Tenn, D. B. Fegles, Minneapolis, George Watson, Dallas, Tex., Matt McDougall, Portland, Ore., J. C. Edwards, Los Angeles, Calif., and H. W. Baum, Salt Lake City.

AMERICAN PUBLIC HEALTH ASSOCIATION, SANITARY SECTION

A meeting of the Sanitary Section of the A. P. H. A. was held in Cleveland, October 16 to 19. A paper on the situation at Lima, O., where a direct oxidation plant recommended by George A. Johnson, and one along standard lines proposed by George W. Fuller are under consideration, was read by the latter engineer. Following a discussion, a committee was appointed by the section to investigate the electrolytic process.

Langdon Pearse read two papers, one a review of the conditions in the larger cities on the Great Lakes as to water supply, sewage disposal and typhoid fever; the other a report on sewage sludge, both of which are abstracted in this issue.

The report of the Committee on Definition of Sewage Treatment Terms was referred back for further consideration. A special committee was appointed to consider the standard specifications for plumbing that have been sent out by the Building Code Committee of the Department of Commerce, Paul Hansen being made chairman.

The following were elected for the coming year: Kenneth Allen, chairman; H. A. Whitaker, vice-chairmen; E. D. Rich, secretary.

BOSTON AFFILIATED TECHNICAL SOCIETIES

The Affiliation Meeting, referred to in our October issue, is set for November 23, with three papers on "Commercial Aviation" as the chief feature. "Commercial Aviation in Europe and the Development of Heavier-Than-Air Machines" will be the title of a paper by E. P. Warner, associate professor of Aeronautical Engineering, of the Massachusetts Institute of Technology. Edward Schildhauer, of the American Investigation Corporation, will discuss "The Development of Lighter-Than-Air Ships." "Boston Air Port" is the title of a paper by James T. Williams, editor-in-chief of the Boston Evening Transcript. These papers will be illustrated by slides and possibly by motion pictures. Prof. Dugald C. Jackson will speak briefly on "The Aims and Accomplishments of the Affiliation." The meeting, which will be held in Tremont Temple at 8.00 P. M., will be preceded by a Smoker at 6.15 P. M., in the Affiliation Rooms, at which the Boston Society of Civil Engineers will act as host.

On December 6, the Boston Society of Civil Engineers, Sanitary Section, will be given an informal talk on "Water Supply and Sewerage in Australia," by A. C. Getteridge, Fellow of the International Health Board.

The Boston Chapter of the American Association of Engineers will hold its regular monthly meeting on December 8.

The Designers Section of the Boston Society of Civil Engineers will meet December 13, when C. B. Breed, professor of Railway and Highway Engineering at the Massachusetts Institute of Technology, will read a paper on "Present Day Developments in Highway Design."

The Boston Society of Civil Engineers at its meeting on December 20, will discuss "The Manufacture and Distribution of Gas." A model water-gas plant in operation will be exhibited.

FOUR-STATE SECTION, A. W. W. A.

There will be a meeting of the "Four-State Section" of the American Water Works Association in Baltimore, Maryland, on Saturday, November 18, 1922.

Members will assemble at the Holliday Street entrance of the City Hall, Baltimore, at 12:30 p. m., whence they will be taken, through the courtesy of the Baltimore City Water Department, by automobile to the Montebello Filtration Plant, where luncheon will be served at 1:00 p. m. Following luncheon a short address will be made by William A. Megraw, water engineer, Baltimore City, after which papers will be read on the subjects given below:

"A Discussion of the Finances and Conduct of Business of a Municipally-Owned Water Works as Segregated from Other Municipal Operations," by V. Bernard Siems.

"Recent Developments in Water Purification at the Montebello Filtration Plant," by James W. Armstrong.

After the reading these papers will be discussed by the members present.

All those so desiring will then be taken to various points of interest about the Baltimore water works. After these trips non-resident members will be taken to the various railroad stations in time to board trains leaving Baltimore around 5:00 p. m.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION

A joint meeting of the North Central Division of the National Highway Traffic Association and the Michigan State Good Roads Association will be held Tuesday, November 21, at Grand Rapids, Mich., at the Hotel Pantlind. In the afternoon George H. Pride, treasurer of the former association and president of the Heavy Haulage Company, of New York, will address the meeting on "Regulations Covering Speeds, Weights and Dimensions of Motor Trucks,

Tractors and Trailers"; "Regulation of Overloading of Motor Trucks" will be discussed by David C. Fenner, manager of Public Works Department, International Motor Co.; and "Lights for Highway Vehicles, Motor-Driven and Horse-Drawn," will be the subject of a paper by David C. Beecroft, vice-president, North Atlantic Division, National Highway Traffic Association.

In the evening Roy D. Chapin, vice-president of the National Automobile Chamber of Commerce and president of the Hudson Motor Car Company, will speak on "Equitable Distribution of Cost of Construction, Interest on Bonds, Replacements and Maintenance of State Highways," and Professor Arthur H. Blanchard, president of the National Highway Traffic Association, on "The Economic Value of Highway Transport Franchises."

NATIONAL MUNICIPAL LEAGUE

The twenty-eighth annual meeting will be held in Philadelphia on November 22 to 24 at the City Club. On the first day action will be taken on the nominations of the nominating committee, including Colonel Henry M. Waite for president, Carl H. Pforzheimer for treasurer, and ten for members of council.

On Wednesday Harlan Updegraff will speak on "The System of State Education in Pennsylvania"; Kenneth L. M. Pray on "The Administration of Charities and Corrections," and H. C. Connell on "Pennsylvania's Road System."

On Thursday "The Wisconsin Idea of Personnel Administration" will be explained by Allen M. Ruggles, service examiner of the Civil Service Commission of Wisconsin; "Civil Service from the Viewpoint of the Administration," by Morris L. Cooke, formerly director of public works of Philadelphia; "Progress in Selective Tests in Public Employment," by Dr. L. B. O'Rourke, of the U. S. Civil Service Commission, and the report of the Committee on New Standards of Municipal Employment will be submitted by the secretary, Dr. W. E. Mosher.

On Thursday afternoon the subject of the discussion will be "The Problem of Criminal Justice." In the evening it will be "Our National Budget." On Friday morning "Reporting Government" will be the topic, and in the afternoon "What's the Matter with Congress?"

PERSONALS

Hammond, A. J., Chicago, in October became associated with James O. Heyworth, of that city, in his engineering and general contracting business.

Worrell, M. L., has been appointed engineer and manager of the water works of Vicksburg, Miss.

Atlee, J. Walter, is located at Ledger, N. C., as engineer with the North Carolina State Roads Commission.

Del Plaine, C. W., is the new field agent of the League of Minnesota Municipalities.

Dimock, Arthur H., formerly city engineer of Seattle, has opened an office in that city and will specialize in hydraulics, waterworks and sanitary engineering.

Uhler, Col. William D., died October 27th after a week's illness. He had been chief engineer of the Pennsylvania State Highway Department since 1915, and had been engaged in highway work since 1904. He was a past president of the American Association of State Highway Officials. He was fifty years of age.

Griffin, J. B., on November 1, became city engineer of Venice, Calif.

Reppert, Charles M., chief engineer of the Bureau of Engineering of Pittsburgh, Pa., has resigned and will enter private practice. He has occupied this position about a year, having formerly been in the firm of Morris Knowles, Inc.

Allen, Robert A., has been appointed state engineer of Nevada. He was for three and one-half years deputy state engineer.

Fitz Randolph, Dr. R. B., chief of the hygienic laboratory of the New Jersey State Department of Health, died October 22. He was fifty years of age.

Coggeshall, R. C. P., superintendent of water works of New Bedford, Mass., died Oct. 20. He had been superintendent of those works for more than 25 years. He was an honorary member and past president of the New England Water Works Association and was its secretary for a number of years.

Flinn, Alfred D., has been elected to fill the new position of Director of the Engineering Foundation, of which he has been secretary for nearly five years. He will continue as secretary of the United Engineering Society but will retire as chairman of the Engineering Division of the National Research Council.

Birdsall, Lewis I., superintendent of filtration of the Minneapolis water works, has resigned to accept a position as water expert with the General Chemical Co. at Chicago.

Mellen, Arthur F., assistant superintendent of filtration of the Minneapolis water works has been appointed superintendent, succeeding Mr. Birdsall.

Neighbour, H. M., recently resident engineer for El Paso County, Tex., has become field engineer on concrete bridges for Maniopa County (Ariz.) Highway Commission.

Wagner, Gerald J., has been engaged by Grand Rapids, Mich., as consulting engineer on public utility matters. He was formerly director of public service.

Gardiner, J. C., has resigned as city engineer of Niagara Falls, Ontario.

Scott, T. S., of Kingston, Ontario, has been appointed city engineer in Niagara Falls, Ontario.

Friel, Francis S., formerly assistant engineer of the Pennsylvania Department of Health, has resigned and become associated with Albright & Mebus, of Philadelphia.

Keeney, Giles B., of Meriden, Connecticut, succeeds Clayton E. Swain as superintendent of public works at Rockville, Connecticut.

Fisher, Chas. F., formerly engineer of the City Planning Commission of Akron, Ohio, has resigned and is employed by Robt. Whitten, Cleveland, Ohio, being at present located at Providence directing studies for the zoning of that city.

Cock, Calvin E., has been appointed county engineer of Neches Co., Texas.

Perie, James, has been appointed city engineer of Ballinger, Tex.

PAMPHLETS

"Mosquitoes of the United States," by Harrison G. Dyar, Custodian of Lepidoptera of the U. S. Museum. This is printed as Bulletin No. 2447 of the Proceedings of the Museum. Lists several hundred mosquitoes under their generic, sub-generic, specific and sub-specific names. Gives complete anatomical and structural description with life history, breeding characteristics, habits, etc. A valuable reference work to one engaged in mosquito control or research work.

"The Re-Heating of Compressed Air," by C. R. Richards and J. N. Vedder. A bulletin of the Engineering Experiment Station of the University of Illinois giving conclusions from an investigation undertaken to determine the ideal thermodynamic efficiencies resulting from the heat expended in re-heating compressed air, the efficiency of external and internal combustion re-heaters, and the performance of an engine operated with air used expansively with steam alone, and with a mixture of air and steam. Published by the Experiment Station at Urbana, Illinois.

"Tests of Drainage Pumping Plants in the Southern States," by W. B. Gregory, irrigation engineer. Bulletin No. 1067 of the U. S. Department of Agriculture, 54 pages in length, describing the types of pumps used in the Gulf coast country, the sources of power, methods and typical results of testing drainage pumping plants (this occupies 70 per cent. of the space in the bulletin), and figures as to cost of operation.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

REDFLEX WARNING SIGNALS.

Signals for highways known as the "Redflex" (also "Greenflex" and "Yelloflex") are being placed on the market by Thompson Brothers Company for use at danger points on highways such as turns, dead ends, railroad crossings, bridges or culverts, and also as a "silent policeman" or street intersection signal.

The "Redflex" consists of specially constructed laminated lens made of pot colored crystal glass of superior brilliancy with a nickeled brass reflector, the lens protected with ¾" expanded metal that has been hot galvanized after being formed. The lens is hermetically sealed in the reflector and these in turn are sealed in a cast aluminum case, while the screen is attached in front of the lens in the same case by means of copper fasteners.

The standard size of lens is 12" square. For most highway work it is attached to a post of 2" galvanized pipe which raises it about 30" above the surface. Above the square lens is placed a danger signal of heavy cast aluminum copper alloy containing raised letters 4¾" high.

The brass reflector has its surface broken into 144 surfaces, each reflecting light at a somewhat different angle.

This signal contains no light in itself and no mechanism, but relies for its efficiency at night upon the fact that if any automobile approaches it with headlights burning the reflector will be lighted by these and the light so received will be reflected back to the driver and appear like a large, brilliant ball of red fire.

The sign is installed by setting the post, which is a 5-foot length of pipe, in a concrete base which insures rigidity and permanence. The lens is then adjusted by an adjusting device so as to reflect the light in the proper way, which will cause it to be visible at a distance of 1,000 ft. or more. The posts are ordinary two-inch galvanized iron pipe and may be purchased at a local plumbing supply store or will be sent by the manufacturer. It is claimed that the light reflected from this lens will penetrate fog, dust, or rain, more effectively than a lighted signal.

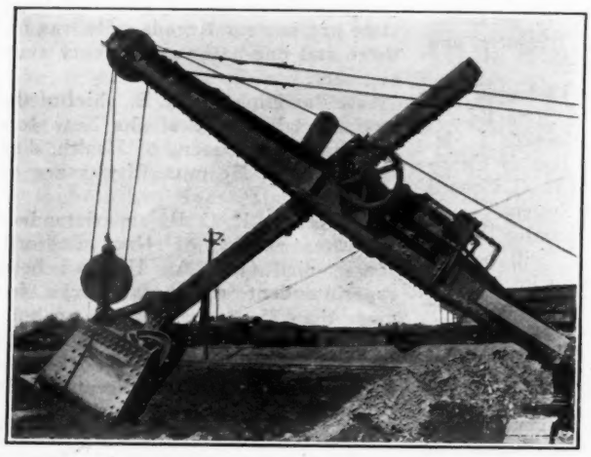
Where used for street intersections, the signal consists of a flat octagonal box of cast steel that rises 6¾" above the street level and contains a "Redflex" lens in each of its eight sides, the lenses being so protected that they canot be hit by traffic. In an emergency a motor vehicle may pass over the signal without serious damage. The base of the signal is 20" in diameter and is set down into the paving material, eight lugs which are cast integral with the base preventing movement of the signal in the concrete or other paving material.

NEW COMBINATION CRANE AND SHOVEL

A combined utility machine for the contractor, supply yard, railroad, or industrial plant, has recently been introduced by the Orton & Steinbrenner Company. This machine is a combination of locomotive crane and steam shovel with continuous tread. Two sizes are manufactured with capacities of ¾-yard and 1-yard, respectively. The change from crane to shovel is made by merely removing the crane boom and substituting the shovel boom and dipper. A separate boom with a skimmer scoop can be connected to the crane independent of the main crane boom, and the hoist line simply reeved over the scoop.

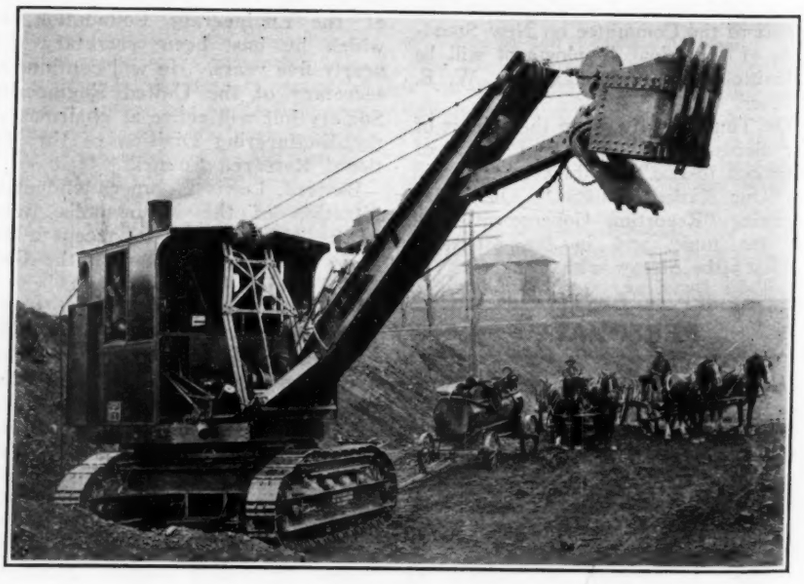
The radius of the boom, instead of being fixed at a certain degree, may be varied to suit the conditions of the job, which feature enables it to dig several feet below the normal operating level and also increases the lift. The rotating base turns on a live ring of rollers on a large-diameter rail circle, thus distributing the load evenly and requiring very little power to swing.

Motive power is supplied by only two engines. The hoisting, swinging and traveling portions are performed



ORTON & STEINBRENNER COMBINED CRANE AND STEAM SHOVEL.

At left is view of boom, showing separate reversing engine to give crowding motion to dipper.



For New and Old Style Buffalo Service Boxes

When a box is equipped with a *MUELLER* Repair Lid it is a better box than it was originally—because the legs of the lid clamp snugly to the sides of the box shaft for about 2½", making it practically impossible to pry off the patented

MUELLER Repair Lids

These Lids meet every known condition where repair is necessary—lost lid, broken leg, and broken top. They set flat on the box top and cannot tip or cock. Many customers are now ordering new boxes equipped with *MUELLER* Lids. Prices on request. Refer to E-850 and E-851, patented.

H. Mueller Mfg. Co., Decatur, Illinois

PHONE BELL 153

Water, Plumbing and Gas Brass Goods and Tools

New York City,
145 W. 30th St.,
Phone Watkins 5397

San Francisco,
635 Mission St.,
Phone Sutter 3577

Sarnia, Ontario, Canada

Mueller Metals Co., Port Huron, Mich., Makers of "Red Tip" Brass Rod; Brass and Copper Tubing; Forgings and Castings in Brass, Bronze and Aluminum; Die Castings in White Metal and Aluminum; also Screw Machined Products.

with double clutches by the main non-reversing engine, while the crowding-motion of the dipper is provided by a separate reversing engine midway along the boom.

The crawling tread is of the flexible type, adjusting itself automatically to the contour of the ground. The tread links are so designed that in passing around the sprocket all foreign materials adhering to them are thrown off and prevented from entering the spaces between the links.

All movable parts are bronze-bushed and lubricated with alemite pressure system, and sheaves and bearings are bronze-bushed. All parts of the machine are accessible and especially those bearing the brunt of the wear, permitting repairs to be made in the field with a minimum amount of lost time.

The car body is built up of structural steel shapes and plates, amply riveted and thoroughly reinforced. The housing is of sheet steel with ample sash and doors, and can be removed when desired. The operator has a clear and unobstructed view of the dipper at all times.

THE AVERY TRACK-RUNNER

A tractor with track-laying equipment is made by the Avery Company, which has designated it the "track-runner." The pads that support it on the ground travel on an oval channel framework which constitutes a track a double row of hardened steel rollers running between the pads and the channels of this frame. The arrangement of the pads is said to be quite novel. Each one of the pads is connected with a hardened steel oblong link by means of a half round pin through holes of corresponding size and shaped in the pad. These pins are put in very tight and it is impossible that there should be any wear on the holes in the pad, but the wear is all in the links and pins, and these, being made of alloy steel, are not very expensive and are easy to assemble.

The lubricating system has been given special attention and a full force-feed type is employed. Lublication of the working parts, which are fully protected from dirt, is effected by means of two lubricators driven from the hub of the countershaft.

Power from the engine is transmitted through a twin-disc clutch to the three-speed selective sliding gear transmission. The entire shaft is carried on anti-friction bearings. With the engine running at 1,000 r.p.m. there is obtained a low speed of two miles per hour, an intermediate of 2.66 and a high of 3.5. The front wheels are turned by the conventional hand-steering wheel. Each track is operated by a clutch and brake lever for very short turning and in operation the right-hand track is released when turning to the left and the left track when turning to the left.

The track is 164 in. long, 48 in. wide over all and has a ground contact 50 in. in length. Each pad is equipped with angle cleats which are held by one bolt, making attaching and detaching of the cleat very easy. Rubber pads for industrial work or work on paved roads are furnished when desired. The machine has an over-all length of 108 in., is 48 in. wide and 58 in. high and weighs about 5,000 lbs. when fully equipped. It is rated at the drawbar to pull three 14 in. mold board plows, or five disc plows, at a speed of 2.66 miles per hour. At the belt it will pull a 24 x 40 in. separator or smaller, with all attachments. A 12 in. x 6½ in. belt pulley running at 1100 r.p.m. is located on the left side of the machine. This pulley revolves when the gear is neutral, is idle when the tractor is doing drawbar work and receives its power and control through the same friction clutch that transmits the power to the tracks. This new tractor is designed by the builders for both farm work and road-building.

AVERY "TRACK-RUNNER" TRACTOR.

G-K PIPE JOINTER

A jointer of water-proof paper that can be used for making joints between sewer pipes of cement grout, heated bituminous compounds, or other poured materials, is about to be placed on the market by the G-K Sales Agency. The object is to make a form that can be attached to the pipe readily and afford a tight envelope into which the jointing material can be poured through a funnel in the top, and which can be left permanently in place so that backfilling can be proceeded with immediately if desired, or water can rise in the trench without softening the cement. The forms will be sold at a price sufficiently low to permit leaving them permanently in place without any great expense to the contractor. The form will be fastened to the bell end and spigot end respectively of the two pipes by means of soft wire twisted together at the top. It will be made of waterproof material so that it will not be softened either by the moisture of the contained grout or by water in the trench outside.

In the case of cement joints, it is necessary, when these are made in the ordinary way, to keep water from the cement for a number of hours, until it shall have reached sufficient set to prevent its being softened by the water and sliding out of the joint. This condition is frequently difficult to secure, with the result that many leaky joints are undoubtedly caused by the softening of the cement at the bottom of the bell. With a form like this to hold the cement in place until it has set, and also to permit pouring a thick grout into the joint and thus insuring that it is completely filled at the bottom, it is believed that a large part of the difficulty in obtaining tight sewers in wet ground will be eliminated.

G-K FORM FOR POURED SEWER JOINTS.

THE SAFETY METER BOX

A box which permits an electric meter to be so installed that it may be read from the outside of the house is manufactured by the Safety Meter Box Company. It is believed that this will save time and trouble to the

NEW CATALOGS

(If you want any of these catalogs send the number with your name and address to PUBLIC WORKS and it will be sent to you promptly without charge or obligation.)

INSPECTED MECHANICAL APPLIANCES

500. Underwriters Laboratories. A list of appliances examined and approved by these Laboratories, which are maintained "for service—not profit," by the National Board of Fire Underwriters. 115 pages, 6x 9.

JOINTING MATERIAL FOR VITRIFIED CLAY PIPE

501. Clay Products' Association. Description of tests made of cement and bituminous jointing materials for obtaining tight joints with vitrified clay pipe, made by S. E. Dibble of the Carnegie Institute of Technology; also a report of the Bureau of Surveys of Philadelphia on the same subject. 12 pages, 6 x 9.

VALVES AND HYDRANTS

502. Michigan Valve & Foundry Company. Describes "Michigan" compression hydrants, water gates, valve boxes, sluicing gates and other water works appurtenances. 12 pages, 6 x 9.

HIGHWAY WARNING SIGNAL

503. "The Warning Sentinel," Thompson Bros. Company. Describes the "Redflex" Warning Signals used at dangerous points along highways, on crossing gates, at bridge portals, etc. 24 pages, 5½ x 8.

CENTRIFUGAL PUMPS

504. Dayton-Dowd Company. Gives description, specification and illustrations of pumps from 1½ in. to 36 in., and for various purposes and with various drives. 32 pages, 7½ x 10½.

AIR COMPRESSORS

505. Westinghouse Traction Brake Company. Describes Westinghouse Steam-Driven Air Compressors used for steam shovels, construction work, road-building and other purposes 12 pages, 8½ x 10½.

SEWER CLEANING EQUIPMENT

506. The Turbine Sewer Machine Company. Describes the turbine sewer machine and gives letters from city officials where it has operated. 72 pages, 7 x 10.

CRUSHING AND QUARRYING MACHINERY

507. Good Roads Machinery Company. Detailed descriptions of Champion rock crushers, elevators, screens, conveyors, portable stone bins, dump carts, rock drills, etc. 36 pages, 8½ x 11.

LINK BELT BELT EQUIPMENT

508. Link Belt Company. A complete new general catalogue embracing the Company's entire line of chains and wheels, gears, transmission machinery, boiler plant equipment, portable loaders, cranes, sand and gravel washing equipment and other machinery. 832 pages.

SCREW ANCHORS

509. Richmond Screw Anchor Company. Describes screw anchors for use in concrete docks, concrete fence posts and poles, and other concrete work. Also concrete form ties and clamps, expansion bolts, pile bands, etc. 32 pages. 6 x 9.

SYMONDS COLUMN CLAMPS

510. Richmond Screw Anchor Company. For clamping forms for concrete columns, with no bolts or nuts or detachable parts. 12 pages. 8½ x 12.

DRAWING AND TRACING PAPERS

511. F. Weber Co. Samples of drawing and detail paper, tracing paper and vellum. Eighteen samples, bound together, 3½ x 6 in.

The Dollar

The daily actions of most of us are influenced by the messages received over the telephone, and yet few of us stop to think of the men and women, and the mechanisms, which help to make that daily service possible.

Maintenance, repairs, and the work of handling calls, must constantly be carried on in good times or in bad, and they must be paid for, in order that your telephone service may be continued.

The average dollar will buy to-day less than two-thirds of what it would buy before the war. This means that it costs, on the average, half as much again to buy most of the things that are necessary for keeping the country going; but the advance in telephone rates is far less than this average.

In fact, gauged by the present purchasing power of the dollar, telephone service in the country as a whole is costing the subscriber less than it did in 1914.

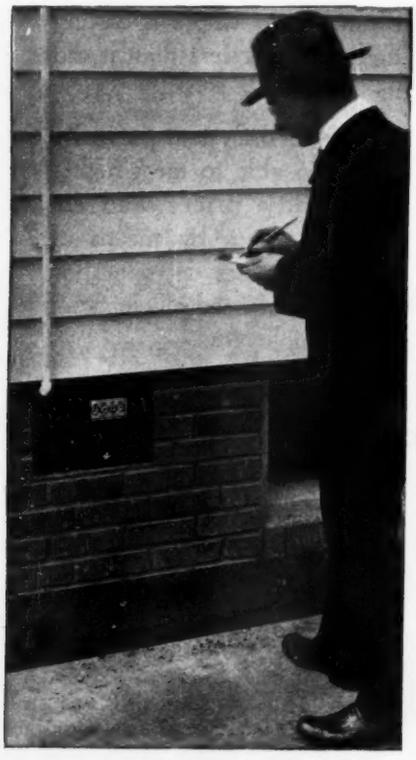
The Bell System generally has been able to meet higher commodity prices and increased wages by means of new economies in operation and the increased efficiency of loyal employees.

"BELL SYSTEM"
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
One Policy, One System, Universal Service, and all directed toward Better Service

Company's employees in reading the meters, since they will not need to enter the house and will not have to make a second trip in case no one is home to admit them, while it will relieve the housewife of interruptions to admit the meter reader and hesitation to do so for fear he is a thief in disguise.

The meter box is built into the foundation of the house and can be read from the outside through a glass window, while the meter itself is accessible from the inside. The service switch as well as the meter are placed in the box, thus eliminating danger of accidental shock to the occupants of the house. Should it be desired by the Company to block the meter when its agent cannot obtain entrance to the house, as when the occupants have moved away, he can break the glass seal, remove the panel, block the switch and replace the panel and a new glass.

The safety meter box is made of heavy-gauge metal and is proof against wear, dust and dampness, fire and shock. The type "C," which is the one most generally used, is 13¾ in. long outside, 10½ in. high and 8¼ in. deep and is furnished with a thirty-ampere two-pole plug fusible switch. Other size boxes are furnished for two-family houses or for service under sixty amperes, while type "B" is provided with angle lugs to offset it from the wall of the house.



READING METER IN SAFETY METER BOX.

INDUSTRIAL NOTES

PRIZES FOR STEAM SHOVEL COST DATA

The Erie Steam Shovel Company expects to render a real service to all owners of excavating equipment by getting together many actual maintenance cost records and publishing them in detail. To secure these actual records they have just announced a prize contest, prizes to be awarded for the best upkeep records. There are twenty prizes, ranging from one hundred dollars and a Waltham watch for first prize, fifty dollars and a Waltham watch for second prize, down to five dollars for twentieth prize. In addition, five dollars will be given for every record that does not win a prize, but is published.

Contractors have from time to time accused equipment manufacturers of too much optimism in giving out figures on maintenance costs. The Erie Steam Shovel Company have always tried to use a great deal of restraint in publishing upkeep records, to avoid leading steam shovel owners generally to expect too much accomplishment with only an average field organization—and now they propose to remove all doubt about actual upkeep costs.

The judges of the contest will be Arthur S. Bent of Bent Bros., the well-known contracting firm of Los Angeles, Calif.; Halbert P. Gillette, editor of "Engineering and Contracting" magazine and author of the "Handbook on Excavation Costs" and many other works on costs; and A. C. Vicary, vice-president of the Erie Steam Shovel Company, mechanical engineer with many years of specialized experience on steam shovel work.

The prize contest opened Oct. 17, and continues until December 31st. Records may be sent in by steam shovel owners, managers, or any employee in direct contact with steam shovel work. In every case, however, the record must be accompanied by a written statement from the owner of the machine to the effect that the figures submitted are correct to the best of his knowledge. The record should include approximate number of days the machine has worked, yardage moved, and class of materials, and all upkeep costs exclusive of cable, dipper teeth and grate bars.

INDUSTRIAL MANAGEMENT AND TECHNICAL AUDITING

The F. S. Pearson Engineering Corporation, 57th Street and Broadway, New York City, has re-established its Department for Industrial Management and Technical Auditing of Industries and Public Utilities. The Department will be carried on together with the usual work of financing, developing, designing and constructing engineering projects and industrial plants.

FRANK M. WILLIAMS JOINS TECHNICAL ADVISORY CORPORATION

Frank M. Williams, state engineer of New York, has joined the staff of the Technical Advisory Corporation as one of its active principals. He will specialize in matters pertaining to the development of water powers, canal construction, highway and pavement construction, the valuation of public utilities and the development of railway and marine terminals.

DEMAND FOR MOTOR BUSES

A large demand for motor buses is being anticipated by the Federal Motor Truck Company, which is preparing to furnish three special types designed for school children transportation, city travel and interurban travel. It is claimed that approximately 400,000 children are being transported to and from school at the expense of the cities and towns of the Country, Ohio, Indiana and Iowa, each spending nearly two million dollars for this service a year. In city transportation, Los Angeles has a bus station from which more than 500 buses leave every twenty-four hours, the Fifth Avenue Coach Company of New York City carried more than 51,000,000 passengers last year, while more than 400 cities in New York State are served regularly by organized bus companies.

SKIP GUARD FOR CONCRETE MIXER

The Chain Belt Company of Milwaukee is equipping its Rex Paving Mixers with an automatically operated guard, which prevents workers from getting beneath the charging skip while it is elevated. Others that have been used, while they guarded the sides, did not prevent any one from getting beneath the skip from the end. Moreover, they interfere with efficient charging. The Rex Skip Guard consists of a frame of steel, which surrounds the skip while it is on the ground, itself resting on the ground; but when the skip is raised the guard rises to a point about three feet off the ground and remains there until the skip is again lowered.

The Standard Inspection Company announces that Ross H. Smith has been appointed Chicago District Manager, with his office at the Peoples Gas Building, 122 South Michigan Avenue.

The Ransom Concrete Machinery Company has decided to again enlarge its plant because of the increased demand for its paving and small mixers. The company doubled its floor space about a year ago, and the new extension will provide an increase of 33 1/3%. This will be in a new one-story building having a monitor roof and covering 10,000 square feet of ground area.

See how the Top and Bottom Casings Part—

when under excessive pressure caused by frost

The patented, non-corrosive, yielding bolt device prevents any damage to the casing or internal mechanism. Relieves you of all expense and annoyance from frozen meters.

This proof device can be used over again after the meter has been frozen, without the need of any new parts.

5 MINUTES' LABOR
the only repair cost

Guaranteed for one year from date of shipment, but will last a lifetime. Made in ⅝, ¾, 1 inch ready to deliver.

THOMSON METER COMPANY
100-110 BRIDGE ST., BROOKLYN, N. Y.

LAMBERT FROST-PROOF METERS

WATER METERS

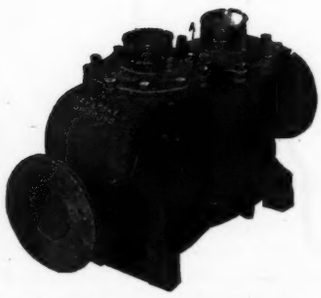
FOR EVERY KIND OF SERVICE

Also Meters for Gas, Oil, Gasoline, Air and Other Fluids

Arctic

Eureka

Accuracy Efficiency and Continued Satisfactory Service at the lowest Maintenance Expense are Characteristic of these Meters.



Keystone-Compound

Keystone

PITTSBURGH METER COMPANY

GENERAL OFFICE AND WORKS, EAST PITTSBURGH, PA.

SALES OFFICES

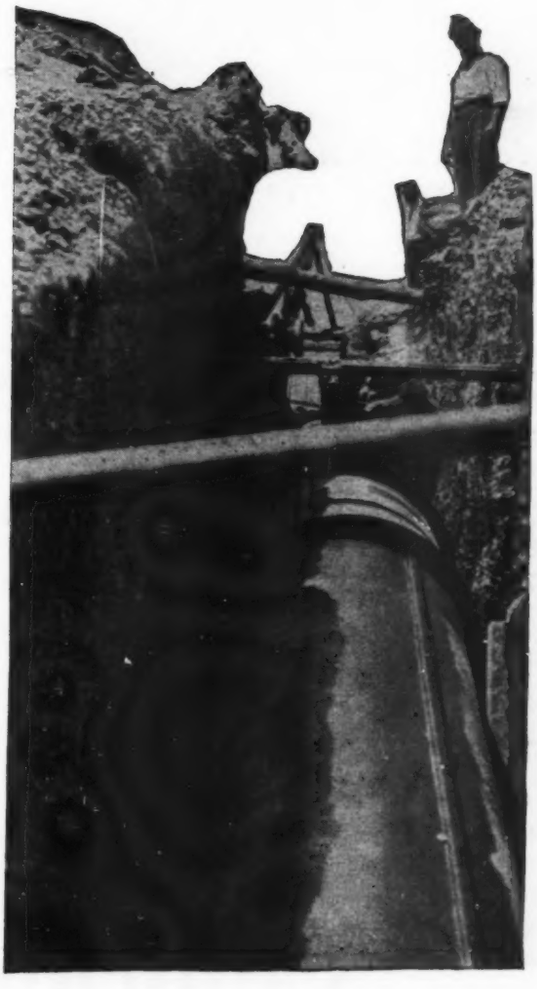
NEW YORK, 50 Church Street
CHICAGO, 5 S. Wabash Avenue
KANSAS CITY, Mutual Bldg.
COLUMBIA, S. C., 1433 Main Street
SEATTLE, 802 Madison Street
LOS ANGELES, Union Bank Bldg.

LOCK-BAR

Before Closing

STRONG AS THE PLATE ITSELF

Not made simply to sell—but to serve



Lock-Bar Steel Pipe will carry approximately 43% greater working pressure than double riveted steel pipe. The longitudinal joint of Lock-Bar is 100% efficient.

On account of the smooth interior of Lock-Bar (absence of rivets, except at circumferential joints thirty feet apart), Lock-Bar is given a preference of 3 inch in diameter over riveted pipe for same carrying capacity.

For like capacity and like pressures Lock-Bar has the advantage of saving in metal on account of smaller diameter and thinner plate. The saving increasing with the diameters and pressures.

Executives write for "Handbook on Pipe"

EAST JERSEY PIPE COMPANY

7 DEY STREET **NEW YORK**

ACCURATE DURABLE
DEPENDABLE

"WATCH DOG"
FROST PROOF METERS

effect an enormous saving in labor and repairs

The Frost Proof Meter may be had in all sizes up to and including 1¼".

The frost plate or bottom cap is brass lined as an added protection to the working parts.

The cap is designed to break when subjected to undue strain. When this fracture occurs, only the plate is damaged, the measuring unit being saved from distortion by the play afforded by the loosened plate. Replacement is easy—the cap is removed, a new one is replaced, and all that remains to be done is to pull up the bolts.

A hammer is unnecessary; no blows are required.

Waterworks officials and superintendents will find our catalogue of special interest.

GAMON METER COMPANY

280-294 SOUTH STREET NEWARK, N. J.

Chemicals for Water Purification

We manufacture the highest grades of

Sulphate of Alumina

also

Chloride of Lime

and

Liquid Chlorine

Pennsylvania Salt Manufacturing Company

WIDENER BLDG. PHILADELPHIA, PA.

100% EFFICIENCY

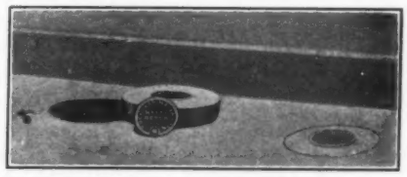
NORTHERN INSTALLATION

THE CLARK METER BOX is adapted to every climate, fits every type and size of meter, and is suited to installation in the lawn, sidewalk and pavement in a uniform manner.

OVER 100 DIFFERENT TYPES AND SIZES provide a perfect fit. **THIRTY YEARS** of successful service in thousands of water departments insures satisfaction to you.

PROTECTION—QUALITY—SERVICE—PRICE is fully covered by the "CLARK ABSOLUTE GUARANTEE—a warrant of satisfaction."

THERE IS A REASON for every detail of construction, accomplishing THOROUGH PROTECTION from frost and protection to life and limb; LOW COST through the most **MODERN MANUFACTURING** process and **LARGE QUANTITY PRODUCTION;** DURABILITY through **HIGH-GRADE MATERIALS AND WORKMANSHIP;** quick operation through **CLARK DESIGN.**



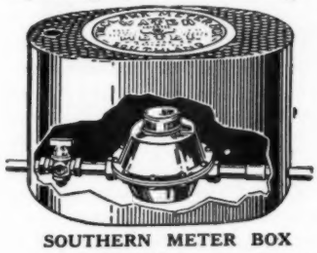
CONCRETE WALK INSTALLATION

We are the **ORIGINATORS** of the hat-shaped **"MERRY WIDOW"** meter box cover and lid. **THERE ARE IMITATORS,** yes, but no equals. **NO INNER LID** used. What's the use? **THIRTY WINTERS** demonstrate the success of Clark design and construction. A meter **NEVER HAS FROZEN** where properly installed in a CLARK METER BOX. **IN LATITUDE 48° NORTH—60° BELOW ZERO**—rather cold—CLARK METER BOXES protect the water meter from freezing.

THE CLARK LOCK

THE CLARK LOCK has no peer. One-piece bolt of phosphor bronze engages on an inclined plane on the cover to lock and likewise engages on a similar plane on the lid to unlock. Only one-third revolution is required to lock or to unlock and without removing the hand. No bolts, screws nor rivets are used in its construction.

NEVER CORRODES NOR STICKS, even when not operated for years. This result is accomplished through three applied principles of construction, viz.: **FIRST,** a very small bearing surface on the locking lug, with an extremely powerful leverage on the handle of operating key; **SECOND,** the operation of locking lug over same surface on cover and on lid; this permits a perfect fit and provides a coating of bronze on the cast-iron surfaces through slight abrasion of the bronze bolt; **THIRD,** the perfect fitting of bolt in a machined hole in lid. This lock **NEVER BREAKS.** Bolt head is of special **CLARK** size (furnished in service box size where desired). Special **CLARK** key. Lock is as secure as a Yale. In case a bolt is lost or stolen, place a new one with this the only tool ever required to repair a CLARK METER BOX. The lock-on lid, being **ALWAYS** in the same position, indicates the proper position from which to read the meter (meter dial having been located properly in relation to the lock), thus greatly "speeding up" meter reading.



SOUTHERN METER BOX

OPEN END RECESS around bolt head prevents accumulation of dirt and insures instant engagement of key.

OVERLAPPING LID (water-shed construction) insures instant replacement without cleaning dirt away.

LID OPENING is either 8" or 11" in diameter (furnished in many special sizes).

SOUTHLAND CLARK METER BOXES are furnished in many models and sizes; oval, square, rectangular or round in shape, to accommodate the curb cock; also, in any length desired.

Clark Meter Boxes—Southern
Clark Meter Boxes—Northern
Clark Meter Testing Machines—Six Models—Bulletin B.
Clark Testing Instruments Increase Earnings—Bulletin C.
The New C. M. B. Service Box Corrects All Service Box Faults, Valve Boxes, Valve Housings, etc.—Bulletin D.
Water Works Pumps of All Kinds—Bulletin E.
Municipal and Miscellaneous Castings—Bulletin F.
Venturi Meters—Check Your Pumpage and Waste—Bulletin G.
CAST IRON PIPE, FIRE HYDRANTS and VALVES, AIR VALVES, BRASS GOODS, etc.—Bulletin H.

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H. W. CLARK COMPANY

EVERYTHING FOR THE WATER WORKS AND MUNICIPALITY

1308 Broadway, MATTOON, ILLINOIS, U.S.A.

New York Sale Lake City Chicago
Memphis San Francisco Buffalo

THE CLARK METER BOX TRADE MARK PROTECTION

RUST ONLY PROTECTS IT

In cast iron rust never penetrates below the surface; the first layer of oxide which it forms acts as a protection, effectively preventing further corrosion. Should the tar coating placed on all water pipe become destroyed, the metal will, in this way, form its own coating.

For this reason cast iron endures under exacting conditions. The history of cast iron pipe, and it goes back for centuries, has not been long enough to establish a limit.

Address Publicity Department, Burlington, for booklets on
Pipe for Water, Gas, Culverts, Fire Protection. Fittings, Standard or Special. Municipal Castings to Engineers' Designs.

United States Cast Iron Pipe & Foundry Co.

General Office: Burlington, New Jersey

SALES OFFICES:

Philadelphia: 1421 Chestnut St.
Pittsburgh: Henry W. Oliver Bldg.
New York: 71 Broadway
San Francisco: Monadnock Bldg.
Chicago: 122 S. Michigan Blvd.
St. Louis: Security Bldg.
Birmingham: 1002 American Trust Bldg.
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Sterling
THE ENGINE of REFINEMENT
For the finest boats that float

EMERGENCY!!

Any intelligent water works or power station employee can operate a STERLING in emergency. Starts electrically, turn on gasoline and water and spark, step on a button —the same as an automobile.

STERLINGS are installed in practically every State in the Union. Over 300 are in use in the United States and Canada, all giving dependable service.

Model GRC 6-cylinder, 225 H. P. STERLING, direct connected to DeLaval 6-inch, 2-stage centrifugal, handling 1,000 Imperial G.P.M., against 350 ft. head at 1,400 R.P.M. Reserve pump installed by Turbine Equipment Co., at Burlington, Ont.

STERLING ENGINE CO., Department C-5, BUFFALO, N. Y.

40 to 300 H. P. at 1200 to 1500 R. P. M.

WATER PIPE—GAS PIPE

NATIONAL Pipe is Made Right—On New Equipment—By Use of Special Cores.

NATIONAL Pipe has Smoothest Inside Finish—Easiest to Work.

PROMPT SHIPMENTS

National Cast Iron Pipe Co.

BIRMINGHAM, ALA.

SALES OFFICES

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1266 Peoples Gas Bldg., Chicago, Ill. **903 Commerce Bldg., Kansas City, Mo.**

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One Billion GALLONS

The total daily capacity of municipal filtration plants installed by us.

500 Communities Supplied

The Dry Feed machine illustrated is the most approved method of feeding chemicals in the science of water treatment. Overcomes the necessity for solution tanks.

The most perfect method of feeding chemicals in dry or powdered form.

NOT AN EXPERIMENT but a PROVEN SUCCESS

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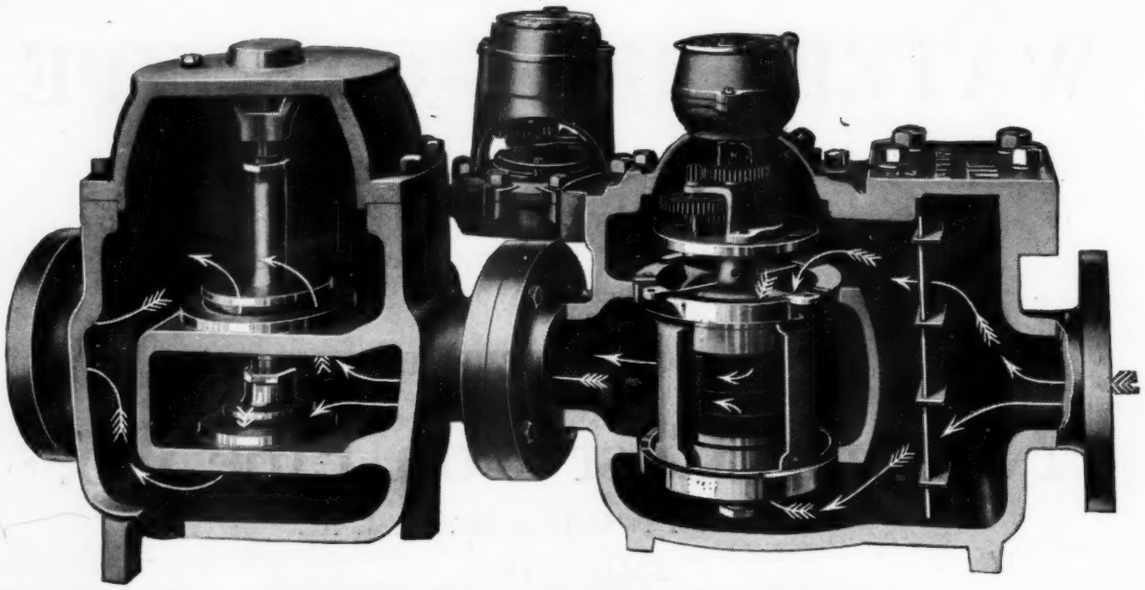
The New York Continental Jewell Filtration Company

Nutley, N. J.

New York Chicago Montreal

The ORIGINAL DRY FEED MACHINE



NILO COMPOUND METER

Consists of three separate and complete units which may be used individually, if desired. Working parts of Nilo Velocity Meters, King Disc Meters and Union Compounding Valves are each assembled in a single unit, readily accessible for inspection without disturbing pipe connections. Catalogue P-52.

Makers of approved water works specialties since 1868.

UNION WATER METER CO. *Incorporated* 1868 WORCESTER, MASS.

UNION WATER METER INC. CO 1868. WORCESTER MASS.

You need this book

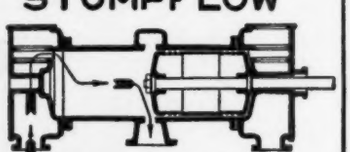
on the

UNA-FLOW STEAM ENGINE

Second English Edition

By Prof. J. Stumpf

STUMPFLOW



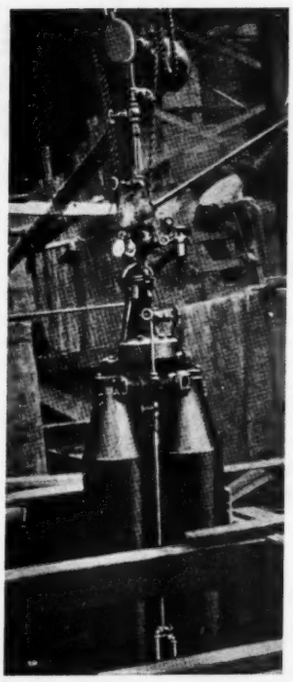
DESIGN

$5 postage prepaid

Write Now about your power problems to his own agent and engineers.

STUMPF UNA-FLOW ENGINE CO., Inc.
206 E. Genesee Street
SYRACUSE NEW YORK

EMERSON PUMPS



ON EVERY CONTRACT

The Emerson Steam Vacuum Pump is practically indestructible, is entirely self-contained, and has no working parts exposed or in sight. No foundation is required. Outside belting, shafting, or engine; self-priming and so simple that skilled attention is unnecessary. Ability to handle solid matter and entrained air without stopping, permits their use on work where other pumps are hopelessly inadequate. They will operate in any position. Requires no exhaust pipe. Steam consumption is low. Takes but little space in shaft.

Catalogue on request.

EMERSON PUMP and VALVE CO.
ALEXANDRIA, VA.

Thaw Your Frozen Service Pipes With ELECTRICITY

Using our Gaso-Electric Thawing Unit.

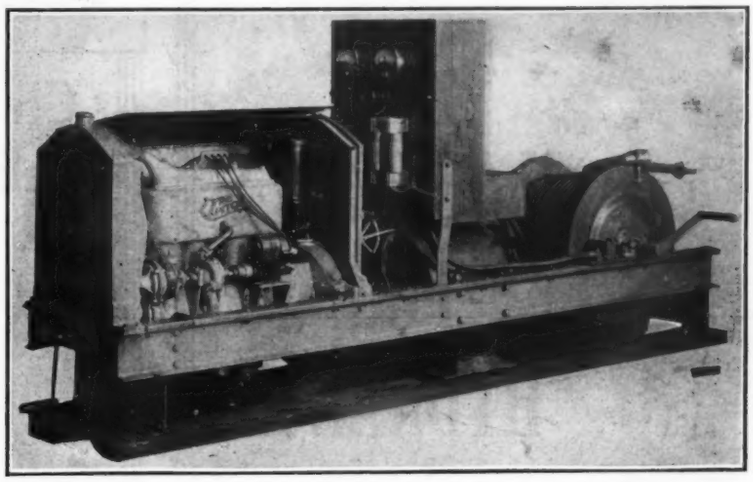
Quick service—extremely low cost per thaw.

Saving in one season will fully cover cost.

A necessity to any city Water Department where freeze-ups occur during winter.

No street disturbance or digging.

Thaw completed in 5 to 10 minutes.



Manufactured by **AUTO ENGINE WORKS**

ST. PAUL, MINN.

SPECIALTIES
FOR WATER WORKS

DEVICES FOR FILLING SPRINKLING WAGONS

WILL pay for themselves in savings effected on repairs to hydrants. Will save great waste of water, as regular hydrants when used are usually left in leaky conditions. No wrenches necessary to operate. Nothing to break. Nothing to get out of order.

PIPE CUTTING MACHINE

Cuts as easily and smoothly as if done in a lathe

No. 1. Size for cutting 4", 6" and 8" pipe.

No. 2. Size for cutting 10", 12", 14" and 16" pipe.

No. 3. Size for cutting 18", 20" and 24" pipe.

No. 4. Size for cutting 30" and 36" pipe.

No. 5. Size for cutting 42" and 48" pipe.

Makers of Smith Tapping Machine, Valves, Lead Furnaces, Pipe Cutting Machines, Gate Valves and Other Water Works Specialties

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THE A. P. SMITH CO., EAST ORANGE, N. J.

MATHEWS FIRE HYDRANTS

• • •

The recognized standard for over 50 years

Frost-Proof
Positively Automatically Drained
Always Dependable

GATE VALVES

FOR ALL PURPOSES

CAST IRON PIPE

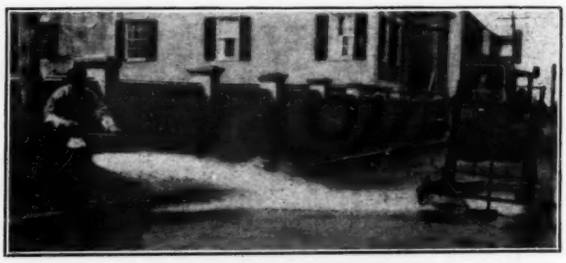
AND FITTINGS

"REDUCED" FITTINGS

Write for Catalog and Prices

R. D. WOOD & CO.

Philadelphia, Pa.



Clean Water Mains Deliver Full Capacity

If there is growth or deposit in your mains it will seriously affect the carrying capacity. It will cost a great deal less to send water through clean mains.

During the past 15 years we have cleaned mains in several hundred cities and the results in increased pressure and reduced operating costs have been thoroughly satisfactory.

We are glad to confer with municipal officials or water companies.

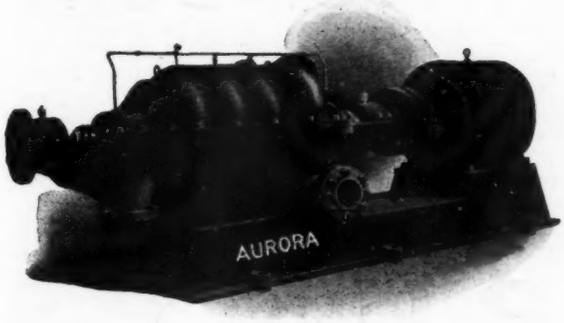
National Methods Are Patented

National Water Main Cleaning Co.

54 Church St. New York

Liquid Chlorine
38740
Your order for a 100-lb. cylinder of CHLORINE will be executed with the same care and promptness as that of a larger quantity.
By the same token and by reason of our facilities, we are able to dispatch a tank car with that same precision and exactitude.
Electro Bleaching Gas Co.
PIONEER MANUFACTURERS of LIQUID CHLORINE
EBG

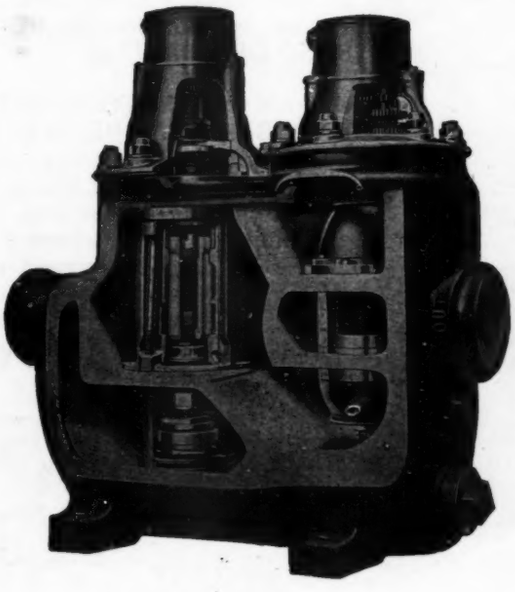
Small in size, but—
Giants for work



AURORA CENTRIFUGAL PUMPS

Aurora Pumps occupy but little floor space. They are compact and sturdily built for hard work. The small number of working parts to wear out reduces upkeep bills to the minimum. High efficiencies insure economy in operation. There is an Aurora Pump for every need—Let us know your requirements and we will recommend the proper style and size.

AURORA PUMP & MANUFACTURING CO.
AURORA, ILL.



When you are taking up the question of water meters why not consider the best that money can buy?

Every engineer and Water Works official knows the wisdom of installing meters of known reliability and accuracy.

Even if it costs a trifle more than some other make, it has the added value and longer life which makes it a better purchase in the long run.

The Badger Compound Meter, illustrated here, is an example of the high efficiency of all Badger Meters.

Special bulletins on all types of Badger Meters sent free on request.

BADGER WATER METERS

BADGER METER MFG. COMPANY
FACTORY AT MILWAUKEE, WIS.

Sales and service offices:

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"MICHIGAN" VALVES

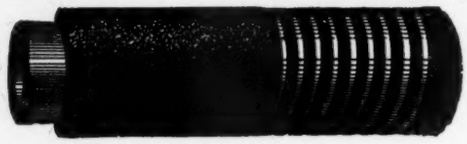
Michigan Valves and Fire Hydrants have been in constant use for many years throughout the United States and Canada and are giving universal satisfaction.

With our increased facilities and the installation of additional modern machinery, we will be able to assure you prompt service.

We solicit your inquiries and will be pleased to submit estimates and supply catalogues upon request.

We manufacture a full line of "Michigan" Fire Hydrants, Water Gates, Valve Boxes, Sleeves and Valves, Indicator Posts, Sluice Gates, Check Valves, Foot Valves, Water Works Supplies, Grey Iron Castings, etc.

MICHIGAN VALVE and FOUNDRY CO. DETROIT, MICH.



It Carries More Water for Its Diameter Than Any Iron Pipe

WYCKOFF WOOD PIPE is not impaired by the effects of electrolysis acid fumes or corrosion. It is light, strong and very durable. Lengths, 6 feet to 12 feet long. Size for size, it carries 14 per cent. more water than iron pipe. Costs less for transportation because it is lighter and easier to handle.

May we send Catalog giving fullest details?

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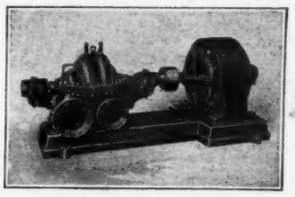
H. H. White - - 1503 Fourth Natl' Bank Bldg., Atlanta, Ga.
Johnson-Peters Co. - - - - Pittsburgh Terminal Warehouse, Pittsburgh, Pa 551 West 14th Place, Chicago, Ill.

DAYTON-DOWD

CENTRIFUGAL



Built for Continuous Economical Service

Investigate!

DAYTON-DOWD CO.
357 York St.
QUINCY, ILLINOIS
Offices in Principal Cities

PUMPS

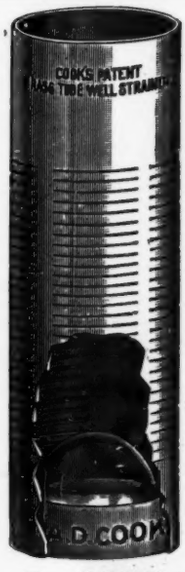
SLUICE GATES

SHEAR, FLAP, PLUG DRAIN AND BUTTERFLY VALVES

FLEXIBLE JOINTS

COLDWELL-WILCOX CO.

Box 574 **Newburgh, N. Y.**



If You Have a DEEP WELL ending in WATER-BEARING SAND OR GRAVEL.

equip it with the COOK PATENT BRASS TUBE WELL STRAINER and secure the maximum capacity of the well free from sand or particles of any kind. These strainers are in use by the Department of Water Supply of New York City, Parkersburg, W. Va., Memphis, Tenn., and Dayton, Ohio.

Upon the completion of the well, allow me to quote upon a Steam Belt or Motor Driven Deep Well Pumping Outlet.

Write for New Catalogue

A. D. COOK, Manufacturer Lawrenceburg, Ind., U. S.

T. J. MITCHELL, Vice-President-General Manager — W. C. HOWE, President — JOHN M. BAILEY, Vice-President-Secretary

Standard Inspection Co.

Inspecting Engineers

954 Century Building **Pittsburgh, Pa.**

INSPECTION

Road building material of all kinds. Cast iron, steel riveted and lock bar pipe. Structural steel for Buildings and Bridges. Inspection Road Building Equipment, new and second-hand. Storage Tanks.

HAVE YOUR MATERIALS INSPECTED AND TESTED—SAVE IN YOUR MAINTENANCE COST

BRANCH OFFICES IN Principal Cities

When You Write Advertisers You Will Do Them and Us a Favor by Mentioning PUBLIC WORKS

A REAL CUSHION TRUCK TIRE

Copyright 1922, by The Goodyear Tire & Rubber Co., Inc.

At the left is seen the famous All-Weather Tread and the Indented Sidewall of the new Goodyear Cushion Truck Tire. Right—a cross-section showing the Goodyear Patented Hollow-Center

Goodyear has produced a real cushion truck tire embodying both the original Goodyear Hollow-Center Cushion and the famous All-Weather Tread.

It unites in one tire the resilience of the cushion, the wearing quality of the solid, and the tractive power of the All-Weather Tread.

It is a development of the standard Goodyear Hollow-Center Cushion Tire, more than 30,000 of which have been proved in actual service during the last five years, and it is a distinct advance on that splendid tire.

The Goodyear All-Weather Tread Cushion Tire has a pressed-on base that defies base-separation troubles.

Its tread is the powerfully tractive All-Weather Tread design, insuring sustained headway under all road and weather conditions, saving fuel and engine strain by its sure gripping.

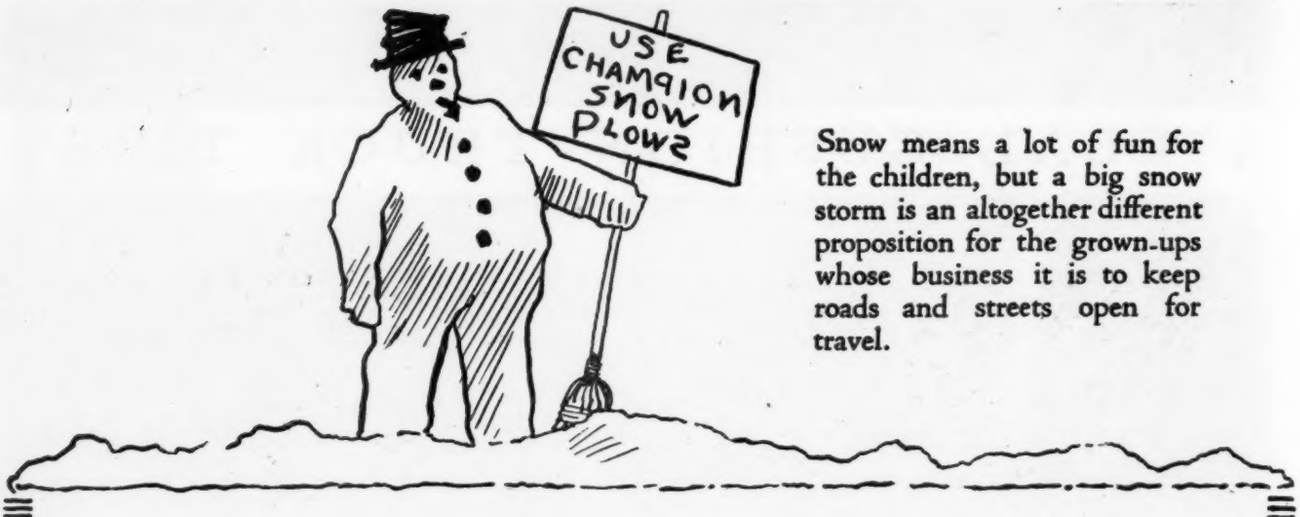
Its triple cushion design makes it a real shock absorber, resilient beyond any other tire excepting the pneumatic. It has the advantage of the patented hollow-center, the high, thick blocks of the All-Weather Tread, and a new sidewall pattern that permits easy compression under pressure.

The Goodyear All-Weather Tread Cushion Tire is made in all standard sizes, up to and including 7 inches, and is specified for all-'round equipment on light and medium duty vehicles and as front wheel equipment with Goodyear All-Weather Tread Solids on the rear, for heavier trucks.

For further information, write the Government Sales Department at Goodyear, Akron, Ohio, or Los Angeles, California.

In placing orders for new apparatus, you should definitely specify this Cushion, unless your needs are for Goodyear All-Weather Tread Solids or Goodyear Cord Truck Tires

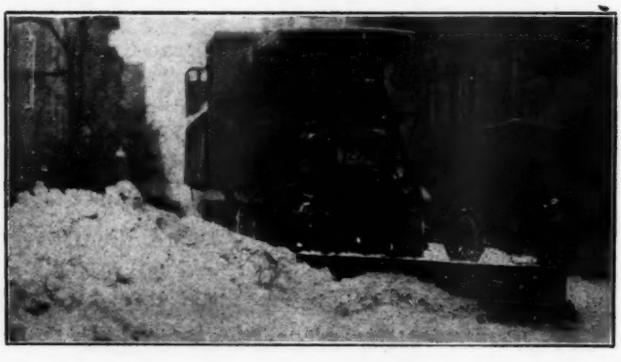
GOODYEAR



Snow means a lot of fun for the children, but a big snow storm is an altogether different proposition for the grown-ups whose business it is to keep roads and streets open for travel.

There was a time—not long since—when the cost of moving snow from public highways by hand labor, the only method then known, was practically prohibitive. To-day a snow storm need not be a nightmare to road and street officials, because the Champion Snow Plow, attached to a motor truck or tractor, will quickly and easily clear snow from highways at small expense.

The Champion Snow Plow which has successfully met the test of of time and service, can be readily attached to any standard make of truck or tractor. It consists of a steel scraper blade which is hung on a semi-circular steel frame, providing angular adjustment, permitting either right or left hand cutting.



The Champion Plow will save its initial cost after one snow storm. It is used and endorsed by town, county, city and state highway departments. No municipality within the snow belt can afford to be without one or more of these plows.

An informing catalog will be sent free to anyone who asks for it.

BOSTON, MASS
NEW YORK, N. Y
PHILADELPHIA, PA.
PITTSBURGH, PA.

The GOOD ROADS MACHINERY Co INC.
KENNETT SQUARE PENNSYLVANIA

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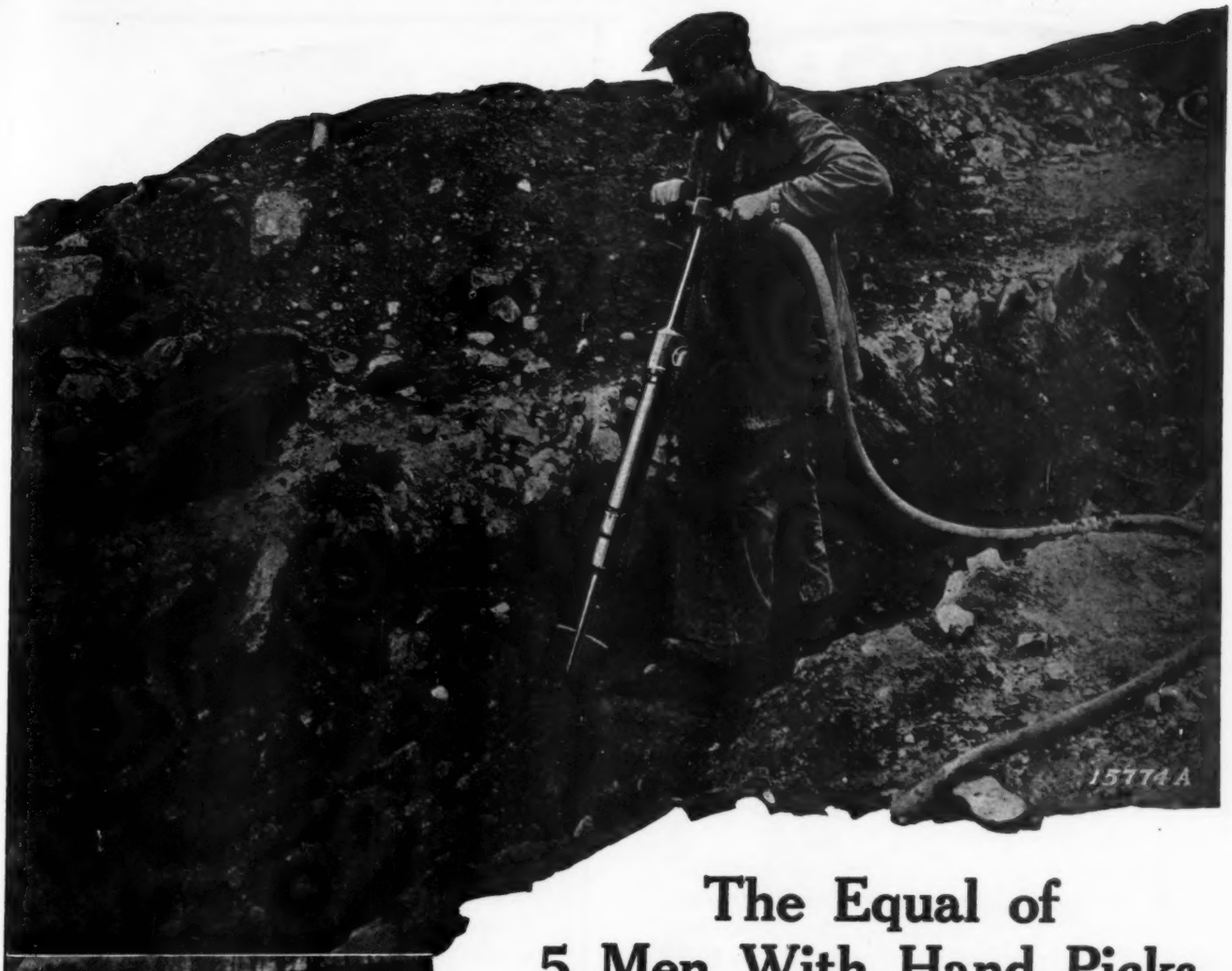

On this trench digging job through clay "Little David" Clay Diggers cut picking costs 80%

The Equal of 5 Men With Hand Picks

THE "Little David" Pneumatic Clay Digger, operated by one man, picks hard dirt, clay and hard pan much faster than five men with ordinary hand picks.

Looking at it another way, one man with one of these air operated picks can easily keep five hand shovelers busy shovelling away the loosened materials. This means a saving as high as 80% in the labor of picking.

The "Little David" Clay Digger is a very rugged and substantial tool that is easy to handle and operate. It will pay you to investigate this new but proven labor saver for your work.

INGERSOLL-RAND COMPANY
11 BROADWAY, NEW YORK
Offices in All Large Cities

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Ingersoll-Rand

DU PONT

3 more per dollar

Will not freeze in any weather

DUMORITE—the new du Pont dynamite which gives you over ⅓ more work for your dollar—is *non-freezing.*

By rigorous laboratory tests and extensive field operations we find that Dumorite can be shot successfully at any temperature. It is just as good in below-zero weather as in the summer time.

Stick for stick, Dumorite does approximately the same work as 40% dynamite, but you can buy 135 to 140 sticks of Dumorite at the same price as 100 sticks of "40%." And Dumorite is a guncotton - nitroglycerin dynamite that will not cause headache.

Dumorite is being used successfully in most kinds of explosive operations. Write our nearest branch office giving details of your particular work and let our Service Department solve the problem of fitting Dumorite to your job. Let Dumorite reduce your explosives bills for 1922.

E. I. du Pont de Nemours & Co., Inc.
Explosives Department
Wilmington, Delaware

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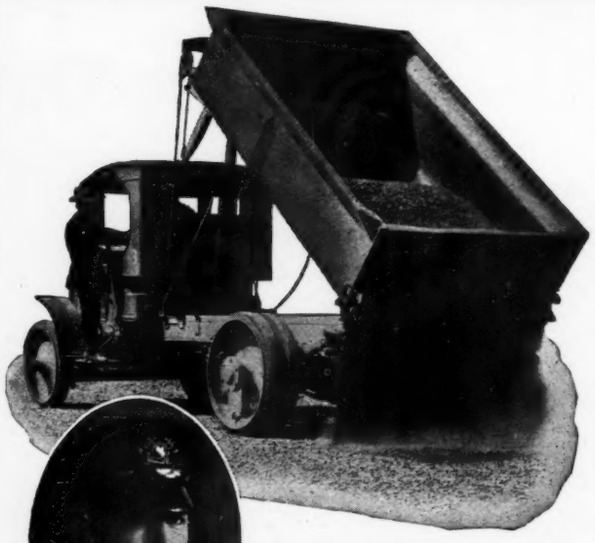
Atlantic City, N. J.



Gar Wood says:
"Wherever there is road-building, there is evidence of the superiority and popularity of Wood-Detroit Hydraulic Hoists and Steel Bodies."

Gar Wood

Built by "Gar" Wood

In every country, in every state, almost in every county—you will find Wood-Detroit Dumping Equipment doing its work, dependably and economically.

For these better hoists and bodies far outnumber all other makes combined.

WOOD DETROIT

Hydraulic Hoists and Steel Bodies

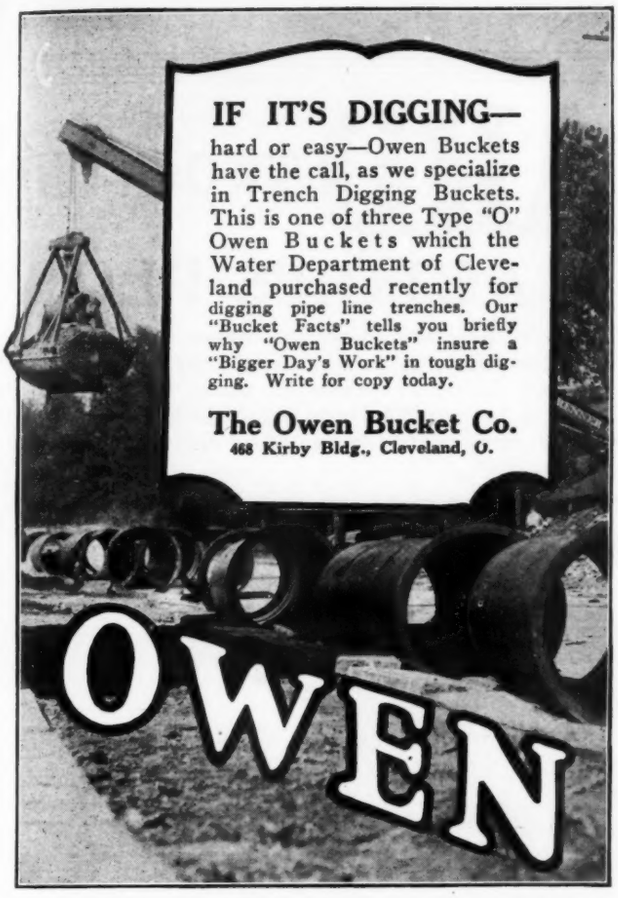
Produced in the largest and finest plant in the world devoted exclusively to the building of hydraulic hoists and steel bodies, and built to the highest standards of material and workmanship, they represent a value that is beyond competition—the choice of over 90% of the truck makers.

Be sure you specify Wood-Detroit Hydraulic Hoists and Steel Bodies.

Wood Hydraulic Hoist & Body Company

7924 Riopelle Street Detroit, Mich.

Sales and Service in All Principal Cities



IF IT'S DIGGING—

hard or easy—Owen Buckets have the call, as we specialize in Trench Digging Buckets. This is one of three Type "O" Owen Buckets which the Water Department of Cleveland purchased recently for digging pipe line trenches. Our "Bucket Facts" tells you briefly why "Owen Buckets" insure a "Bigger Day's Work" in tough digging. Write for copy today.

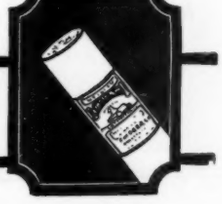
The Owen Bucket Co.
468 Kirby Bldg., Cleveland, O.

Drawing & Tracing Papers

Of Pre-War Quality
For All Purposes

WE have just completed arrangements with several leading foreign mills for their output of the highest quality paper for drawing, tracing and water-colors.

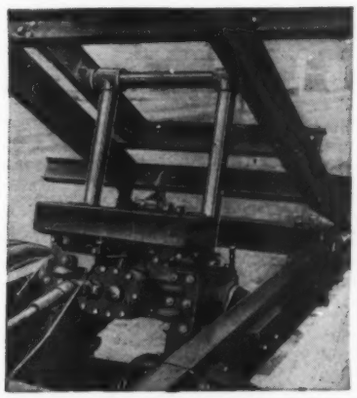
A copy of our Sample Book awaits your request.



F. WEBER CO
St. Louis PHILADELPHIA Baltimore

"HYDRO HOISTS require so little attention," writes Barney Cushman, of the Cushman Wright Contracting Company, Chicago. Hundreds of other contractors who are using Heil Dumping Equipment on their trucks have had the same experience.

"Not one cent for repairs, and I've dumped loads under conditions one would think impossible"—"Save more time and get better results with the Heil Hoist"—"Not one minute's trouble"—"An ideal unit for general dump truck work"—"Well satisfied"—"Can be depended on." These are a few opinions from fleet owners in California, New Jersey, Minnesota and Illinois.



Upper View—2 yd. 2 "Batch" Model SSC Dump Bodies and No. 4 Hydro Hoists on 2-ton Trucks. Dumping angle 54 degrees.
Lower View—Typical installation of Hydro Hoist on truck. Note its simplicity and compactness. There is no lost space with the Hydro Hoist.

Literature on Dump Bodies and Hoists for road building, construction work, asphalt, ash and garbage hauling, sent on request. Special folder on Bodies Equipment for Ford Trucks. Write today.

THE HEIL CO.
1132-50 Montana Ave., Milwaukee, Wis.
Sales and Service Stations
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Quality TANKS BODIES & HOISTS "Made by Heil"

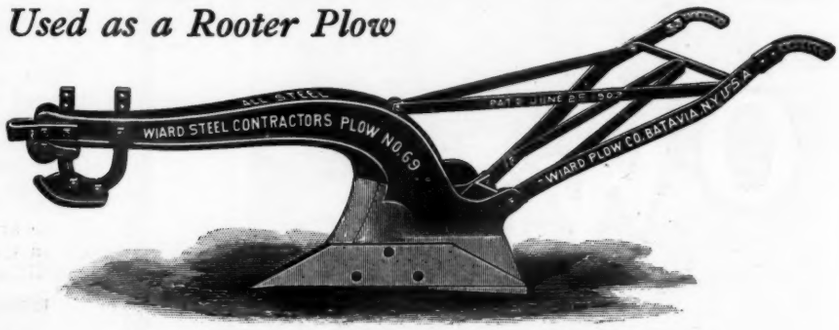
WIARD TWO-IN-ONE CONTRACTOR'S PLOW

For tearing up cobblestones and macadam. By simply removing the steel wing below the mold-board, it can be used as a perfect rooter or pavement plow. The Wiard does the work of both and means a less investment and keeping in stock extra parts for one plow only.
Light and Strong.

We make a full line of plows for every requirement. Write for descriptive literature and prices.

Wiard Plow Co.
BATAVIA
N. Y.

Used as a Rooter Plow



No. 69 (All Steel) Contractors' Plow, Landside View

How many bids did you get on your last call?

Not more than six, most likely. Probably none.
Why?

Because an ad in your official paper is not enough. Neither is a notice in the engineering papers that "Bids are asked on contemplated work."

Contractors want a more detailed description than that before they ask for plans and specifications.

Put your call for bids in the Official Advertising columns of PUBLIC WORKS and you won't be tied to the bids of local men. You'll get a larger number of bids and can choose one within the engineer's estimate.

It will cost you only $2 an inch, and may save you several thousand dollars on one job.

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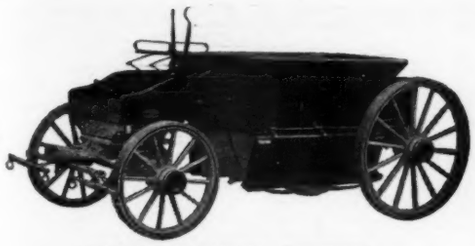

SUSQUEHANNA MODEL
From 1½ yards to 3 yards Capacity.

The strongest dump wagon you ever used

Unusually desirable for road work

A Prominent Contractor said—"You Can't Beat It For Service"

In closing the bottom doors, one side always shuts first, making a dirt-tight joint. Has light draft, large wheels and short turning radius.

We build the Jennings Automatic Dump body for Fordson and other makes of ton trucks.

Send for descriptive literature and prices

The Columbia Wagon and Body Co.
Columbia, Pa.

NEWPORT CULVERTS

THE well-known strength of corrugated metal insures the purchaser of Newport Culverts that he is getting the maximum strength for supporting the overburden and traffic load. Made in full-round and half-round shapes to fit every condition. The moderate first cost is the only cost. They last a life-time. Full descriptive literature sent free on request.

100% QUALITY

NEWPORT CULVERT CO., *Incorporated*
542 W. 10th Street **Newport, Kentucky**

for STRENGTH

Build a Road That Resists Bombardment

When the mighty guns on the Western front hurled broadsides of ponderous steel projectiles, the turrets and forts, regarded as impregnable, crumpled like cardboard. The result was a resort to earth trenches and embankments. Why? Because the only resistance possible was that of absorbing the shock instead of defying it. The same principle dictates shock absorbers and pneumatic tires for automobiles and trucks to protect the vehicle and its load. Our streets and roads must withstand the bombardment of more than four million truck wheels. The shock absorber in this case is the asphalt wearing course whatever the base. Asphalt—resilient, dustless, noiseless, waterproof, wearproof—the pavement of Broadway, Fifth Avenue, Michigan Boulevard, Broad Street, and Pennsylvania Avenue, is the last word in modern pavement design and is no more costly than a rigid, unprotected pavement.

Write for Brochures, Circulars and Specifications

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Blawforms for Streets & Sidewalks

For cheap, quick and good construction add to your street building equipment a set of Blaw Universal Forms—the rails are so designed that forms of any shape or width of curb, gutter, combined curb and gutter, or sidewalk can be built, requiring only the necessary dividing plates.

Our method of staking these forms holds them in rigid alignment and the Blaw Patented Slip Joint Connection (an integral part of each rail) provides a tight, stiff and smooth joint which permits their being erected and dismantled, by unskilled labor, in a fraction of the time required with wood forms.

Blaw Universal Forms are economical because they enable you to complete your job in quicker time with unskilled labor, and give better results than any other type of form. They pay for themselves out of increased profits on the very first job—and you get these increased profits on every succeeding job you undertake.

"The World's Largest Builders of Steel Forms"

BLAW-KNOX COMPANY
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NEW YORK · BOSTON · CHICAGO · DETROIT · SAN FRANCISCO

DURABLE!

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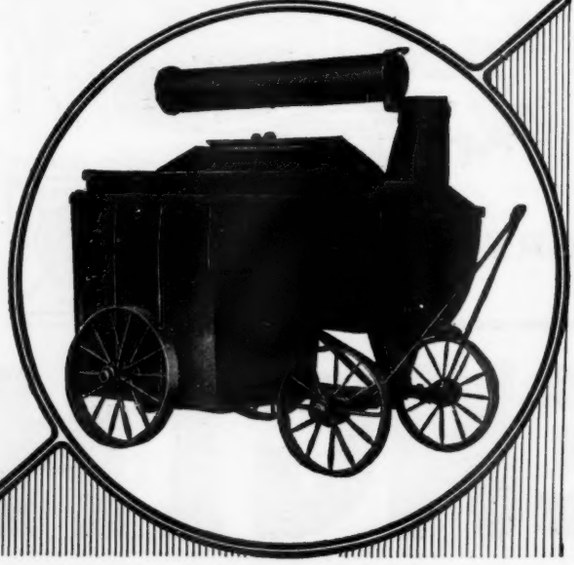
Write today for full description and new low prices. We can save you money.

STANDARD STEEL WORKS
16th and Holmes Streets North Kansas City, Mo.



STANDARD Asphalt Products

Standard Asphalt Binder A *for surface treatment.*
Standard Asphalt Binder B *for penetration work.*
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Standard Refined Mexican Asphalt *for sheet asphalt paving.*
Standard Asphalt Joint Fillers *for brick or block pavements*
Standard Paving Flux, Standard Bridge Asphalt and Preserving Oils.

STANDARD OIL CO. OF NEW YORK
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Specifications and all other particulars furnished on request.

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STANDARD OIL CO OF NEW YORK

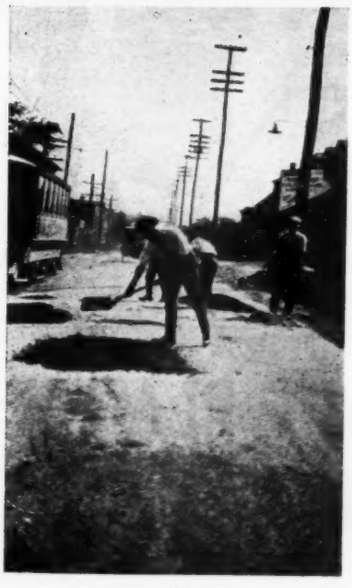
OUR more than thirty years' experience enables us to select materials and design equipment which will render the best service. The number of Buffalo-Springfield Rollers now in use is not equalled by that of any other make of roller produced in America or abroad.

Manufactured in all types and sizes, steam and motor. Get full particulars regarding them.

The **Buffalo-Springfield Roller Co.**
Springfield, Ohio

BUFFALO-SPRINGFIELD ROLLERS

COLD PATCH



(1)
Repairing Bituminous Concrete

(2)
Same, two months later, showing repairs after being consolidated by travel

HEADLEY No. 1
AN ASPHALTUM EMULSION

For repairs and resurfacing.

No expensive heating plant required.

Can be used in wet or dry weather.

No time lost account wet materials.

Write for descriptive booklets.

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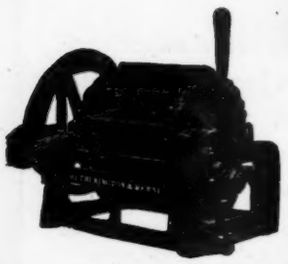
HEADLEY GOOD ROADS CO. FRANKLIN TRUST BUILDING PHILADELPHIA, PA.



H&B PAVING BRICK TESTING MACHINE

Illustration shows N. P. B. M. Standard Rattler for testing of paving brick.

COMBINES ALL THE LATEST IMPROVEMENTS
and requirements of construction

Thoroughly tested and tried out for a period of one year under the direction of the technical committee of the National Paving Brick Manufacturers' Association.

Write for descriptive circular and prices.

HETHERINGTON & BERNER
INDIANAPOLIS, INDIANA

LOAD A FIVE-TON TRUCK FOR TWENTY-FIVE CENTS

By Using a
RELIANCE PORTABLE CAR UNLOADER
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CAPACITY 25 TO 35 TONS AN HOUR

BEARS THE USUAL GENEROUS RELIANCE GUARANTEE
PRICES QUOTED WILLINGLY DELIVERIES MADE PROMPTLY

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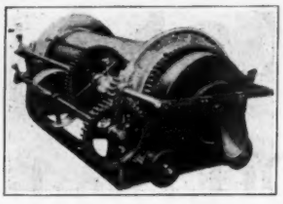
KINGSTON, N. Y.
RELIANCE ROAD BUILDING-LABOR SAVING EQUIPMENT



Washes

Gravel, Sand
Crushed Rock

Stocker Improved Concrete Material Washer

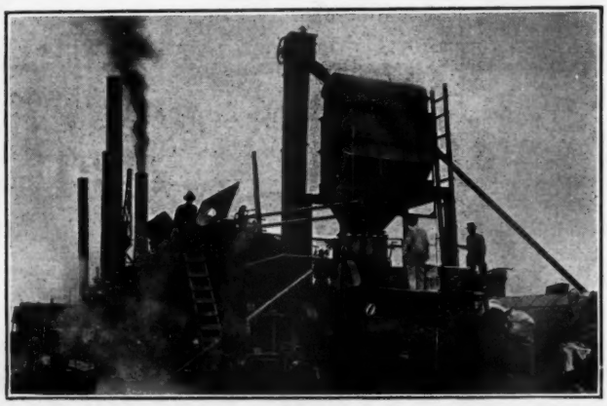
Rakes and scoops the material against a constant flow of water, which frees it from dirt, clay and other impurities. Easily moved from one job to another—it is portable. All parts are interchangeable. Washes ten or more tons per hour. Write for further information.

P. M. WIEBE & SON - Highland, Illinois

Honhorst Tar and Asphalt Heaters

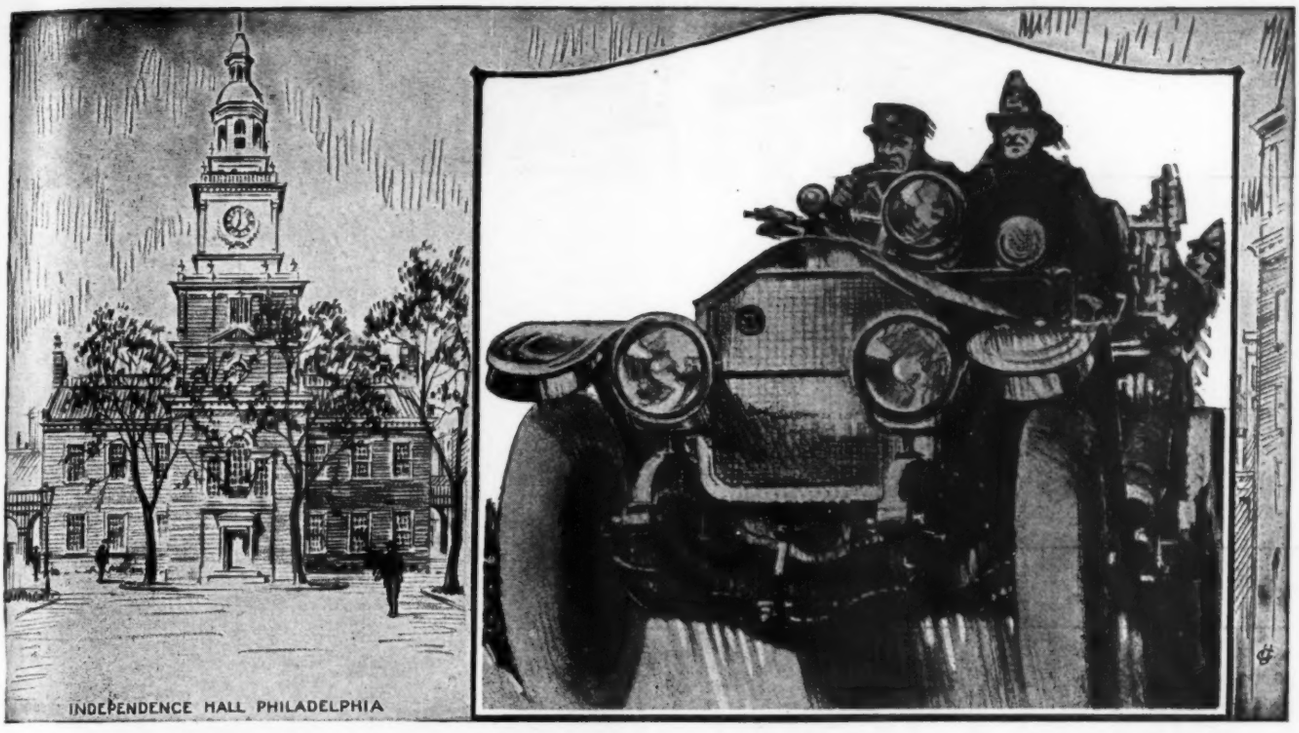
Sand Dryers
Steel Stacks
Tool Heaters
Boiler Breechings
Welded or
Riveted Tanks

THE JOS. HONHORST CO.
Cincinnati : 1016 W. Sixth Street : Ohio



ASPHALT PLANTS ALL TYPES

The J. D. Farasey Mfg. Co.
Cleveland, Ohio



PHILADELPHIA PURCHASES AMERICAN-LAFRANCE APPARATUS

Contract Placed as Result of Exhaustive Tests

After examining the most minute details of the construction of practically every type of fire apparatus, the City of Philadelphia decided that American-LaFrance was best qualified to serve it. The result was an order for 42 pieces, 21 Pumpers and 21 Combination Cars.

This is the Largest Contract for Motor Fire Apparatus Ever Recorded in the History of the Business.

It is a fitting tribute to the engineering principles that have put American-LaFrance Fire Apparatus in 90 per cent of America's fire departments.

Within the same month New York City has placed an additional order for 21 pieces and Boston for 10 more pieces.

AMERICAN-LAFRANCE FIRE ENGINE COMPANY, INC.

ELMIRA, N.Y.

BRANCHES
NEW YORK
BOSTON
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CHICAGO
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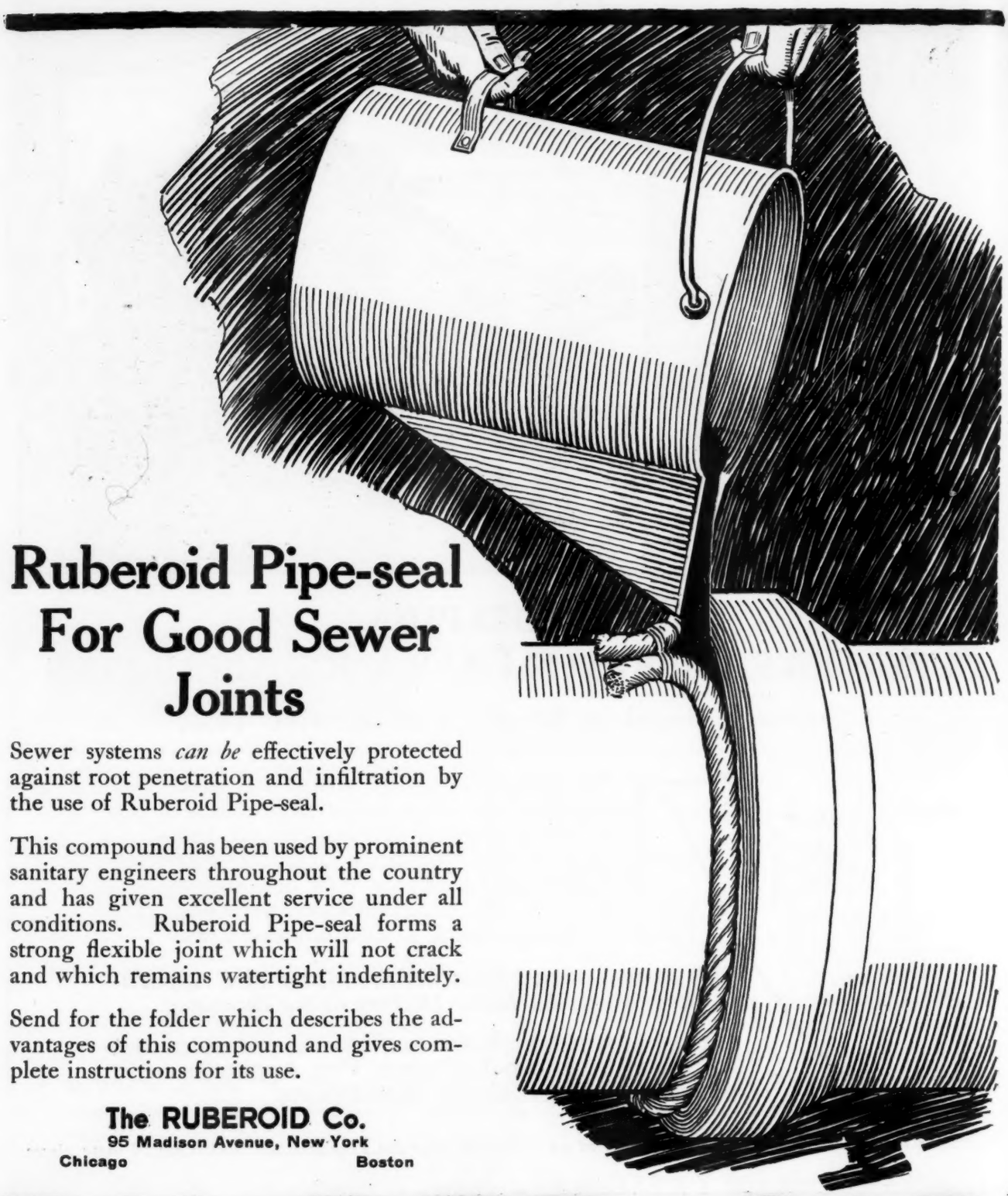

Ruberoid Pipe-seal For Good Sewer Joints

Sewer systems *can be* effectively protected against root penetration and infiltration by the use of Ruberoid Pipe-seal.

This compound has been used by prominent sanitary engineers throughout the country and has given excellent service under all conditions. Ruberoid Pipe-seal forms a strong flexible joint which will not crack and which remains watertight indefinitely.

Send for the folder which describes the advantages of this compound and gives complete instructions for its use.

The RUBEROID Co.
95 Madison Avenue, New York
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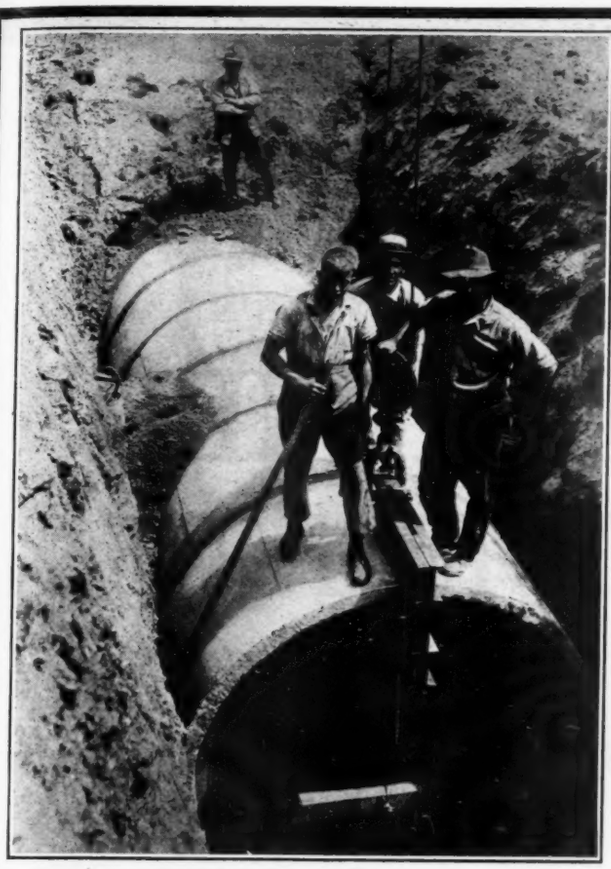
RU-BER-OID
Pipe-seal



Installation of 78" Independent Reinforced Concrete Pipe for Northeastern outlet, Pontiac, Michigan. Note method of laying pipe. Line installed by Caffrey & Bahin, Contractors, of Springfield, Ohio, under the supervision of L. G. Lenhardt, City Engineer of Pontiac, Mich.

Reinforced Concrete Pipe *for* Permanence

Permanence is the most desired quality in sewers, drains or culverts. Municipalities are installing greater and greater quantities of Reinforced Concrete Pipe because it is permanent construction. We have the data ready for you, whether you are engineer, municipal official or contractor—proving that Independent Reinforced Concrete pipe has many points of superiority over other forms of sewer materials.

It requires no repairs. It defies all the usual causes of deterioration and it LASTS most satisfactorily to all concerned. Allow us the pleasure of mailing you some facts about INDEPENDENT CONCRETE PIPE.

Independent Concrete Pipe Co.

Indianapolis, Indiana

Easier to Lay

—

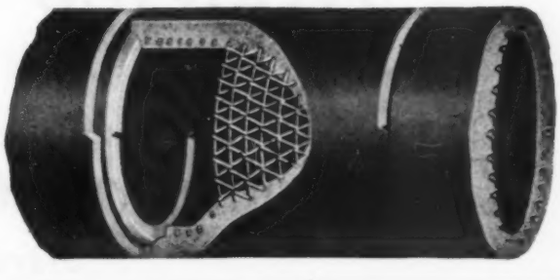
Cheaper to Lay

—

Faster to Lay

Joints

Our joints insure a strong, durable and water tight connection.



VITRIFIED SEWER PIPE

from 8 Ohio Plants

Prompt Shipments

The Ohio Vitrified Pipe Co. Uhrichsville, Ohio

We ship Promptly

Try us on any quantity of

VITRIFIED SEWER PIPE

12 Plants
110 Cars Per Day

"Watch Our Speed"

The Robinson Clay Product Co.

Akron, Ohio

Why should there be a Sewage Disposal "Problem"?

Direct Oxidation plants dispose of sewage without nuisance 365 days a year. Their installation and operation are no more a "Problem" than the building and operation of a lighting plant or a water pumping station.

Municipal Direct Oxidation Plant at Allentown, Pa. (Pop. 85,000)

Direct Oxidation plants may be located at the most economical point, without regard to isolation, as they produce neither odors nor flies.

DIRECT OXIDATION DISPOSAL CORPORATION

LAND TITLE BUILDING

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Authoritative Reports and Valuations covering Public Utility, Municipal, Mineral, Industrial, Commercial and Residence properties.

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Water Supply. Sewerage and Disposal. Lighting Plants—Supervision of Construction and Operation. Appraisals—Expert Testimony.

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Appraisals, Expert Testimony, Sewerage, Rate Investigations, Water Works, Lighting.

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Water Analysis and Tests of Filter Plants

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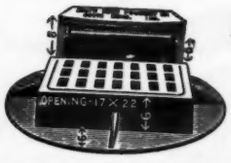

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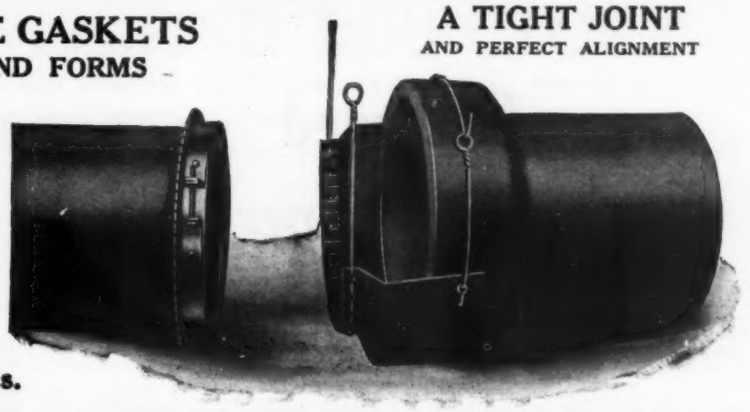

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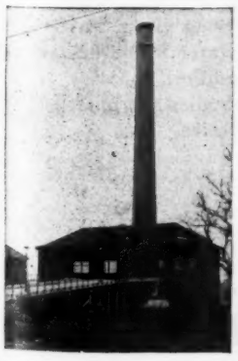

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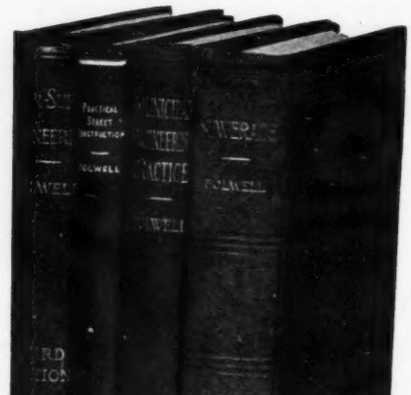

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Sweet's Steel Co.	—
T	
Texas Co.	18, 60
The Martinique	—
Thomson Meter Co.	27
Tiffin Wagon Co.	—
Truscon Steel Co.	3
U	
Union Water Meter Co.	34
U. S. Cast Iron Pipe & Fdy Co.	32
Universal Road Mach. Co.	48
V	
Vulcan Incinerator Co.	57
W	
Warren Bros. Co.	10
Weber, F. Co.	43
Weston, L. A.	57
Wiard Plow Co.	44
Wiebe, P. M.	48
Wood, R. D., & Co.	36
Wood Hydraulic Hoist & Body Co.	42
Wyckoff & oSn Co., A.	38

BUYERS' CLASSIFIED DIRECTORY

(CONTINUED)

Inlet Basins
Flockhart Foundry Co.

Joint Compound (Bituminous)
Ruberoid Co.

Manhole Heads
Flockhart Foundry Co.

Pipe (Cast Iron)
Nat'l Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdry. Co.
R. D. Wood & Co.

Pipe Cleaning Machines
W. H. Stewart

Pipe (Reinfr. Concrete)
Independent Con. Pipe Co.

Pumps
Aurora Pump & Mfg. Co.
De Laval Steam Turbine Co.

Rods
W. H. Stewart

Segment Block Sewer
Robinson Clay Prod. Co.

Sewage Disposal Apparatus
Direct Oxidation Disposal Corp.
Pacific Flush-Tank Co.

Sewage Disposal Plants
Direct Oxidation Disposal Corp.
Sanitation Corporation

Sewage Disinfection
Direct Oxidation Disposal Corp.
Electro Bleaching Gas Co.

Sewage Ejectors
Pacific Flush-Tank Co.

Sewage Pumps
De Laval Steam Turbine Co.

Sewer Joint Compounds
G. K. Sales Agency
Pacific Flush-Tank Co.

Sewer Castings
Flockhart Foundry Co.

Vitrified Fire Clay Sewer Tiles
East Ohio Sewer Pipe Co.
Robinson Clay Prod. Co.

Vitrified Sewer Pipe
Eastern Clay Products Association
East Ohio Sewer Pipe Co.
Ohio Vitrified Pipe Co.
Robinson Clay Prod. Co.

STREET CLEANING AND REFUSE DISPOSAL

Ash Bodies
Heil Co.

Ash Cans
Rochester Can Co.

Carts
Acme Road Mchy. Co.
Columbia Wagon & Body Co
Tiffin Wagon Co.

Garbage Bodies, Steel
Columbia Wagon & Body Co.
Heil Co., The

Incinerators
Decarie Incinerator Co.
Stacy-Bates Co.
Vulcan Incinerator Co.

Manholes—Catch Basins
Burch Plow Works Co.
Wm. E. Dee Co.
South Bend Foundry Co.

Shovels
Rochester Can Co.
Wyoming Shovel Works

Sprinkling Wagons and Flushers
Austin-West. Rd. Mach. Co.
Etnyre & Co., E. D.
Good Rds. Mchy. Co., Inc.
The Kinney Mfg. Co.
Tiffin Wagon Co.

Street Flushing Hose
Goodyear Tire & Rubber Co.

Street Scrapers
Rochester Can Co.

Street Sweepers
Austin-West. Rd. Mach. Co.
Ohio Municipal Equip. Co.
Universal Road Machinery Co.

STREET SIGNS

Ingram-Richardson Co.

WATER WORKS

Air Compressors
Ingersoll-Rand Co.

Air Lift
Ingersoll-Rand Co.

Brass Water Connection
Mueller, H., Mfg. Co.

Centrifugal Pumps
Aurora Pump & Mfg. Co.
De Laval Steam Turbine Co.

Chloride of Lime
Penn Salt Mfg. Co.

Chlorine Liquid
Electro Bleaching Gas Co.

Deep Well Drills
Ingersoll-Rand Co.

Deep Well Pumps
Aurora Pump & Mfg. Co.
Cook, A. D.
Ingersoll-Rand Co.

Disinfecting Chemicals
Electro Bleaching Gas Co.
Penn Salt Mfg. Co.

Filters
N. Y. Continental Jewel Filtration Co.

Filtration Plants

Filter Alum
Du Pont de Nemours Co.

Fire Hydrants
Clark Co., H. W.
R. D. Wood & Co.

Flap Valves
Coldwell-Wilcox Co.

Meters
Badger Meter Mfg. Co.
Clark Co., H. W.
Hersey Mfg. Co.
Pittsburgh Meter Co.
Thompson Meter Co.
Union Water Meter Co.

Meter Boxes
H. W. Clark Co.
Pittsburgh Meter Co.

Meter Testing Machines
H. W. Clark Co.
Mueller, H., Mfg. Co.
Pittsburgh Meter Co.

Pipe, Cast Iron
National Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pipe, Steel
East Jersey Pipe Co.

Pipe, Wood
A. Wyckoff & Son Co.

Pumps
Aurora Pump & Mfg. Co.
H. W. Clark Co.
Cook, A. D.
Dayton-Dowd Co.
De Laval Steam Turbine Co.

Pumping Engines
De Laval Steam Turbine Co.
Sterling Engine Co.

Screens for Wells
Cook, A. D.

Service Boxes
Mueller, H., Mfg. Co.

Shear Valves
Coldwell-Wilcox Co.

Sleeves and Valves
Mueller, H., Mfg. Co.
Smith, A. P., Mfg. Co.

Sluice Gates
Coldwell-Wilcox Co.

Sprinkling and Flushing Hydrants
Mueller, H., Mfg. Co.

Steel Stacks
Heil Co., The
Honhorst, Jos., Co.

Strainers
Cook, A. D.

Tanks
Etnyre & Co., E. D.
Farasey, J. D., Mfg. Co.
Heil Co., The
Honhorst, Jos., Co.

Tanks, Towers, Standpipes
Connery & Co., Inc.
Farasey, J. D., Mfg. Co.

Tapping Machines
Mueller, H., Mfg. Co.
Smith, A. P., Mfg. Co.

Tunnel Liner Plates
Truscon Steel Co.

Valves
Clark Co., H. W.
Mueller, H., Mfg. Co.

Vitrified Pipe
Eastern Clay Products Association

Water Main Cleaning
National Water Main Cleaning Co.

Water Purification
Electro Bleaching Gas Co.
N. Y. Continental Jewell Filtration Co.

Water Sterilization
Electro Bleach Gas Co.

Water Strainers
Mueller, H., Mfg. Co.

Water Supply from Well Systems
Cook, A. D.
Heil Co., The

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